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VOL. VI.

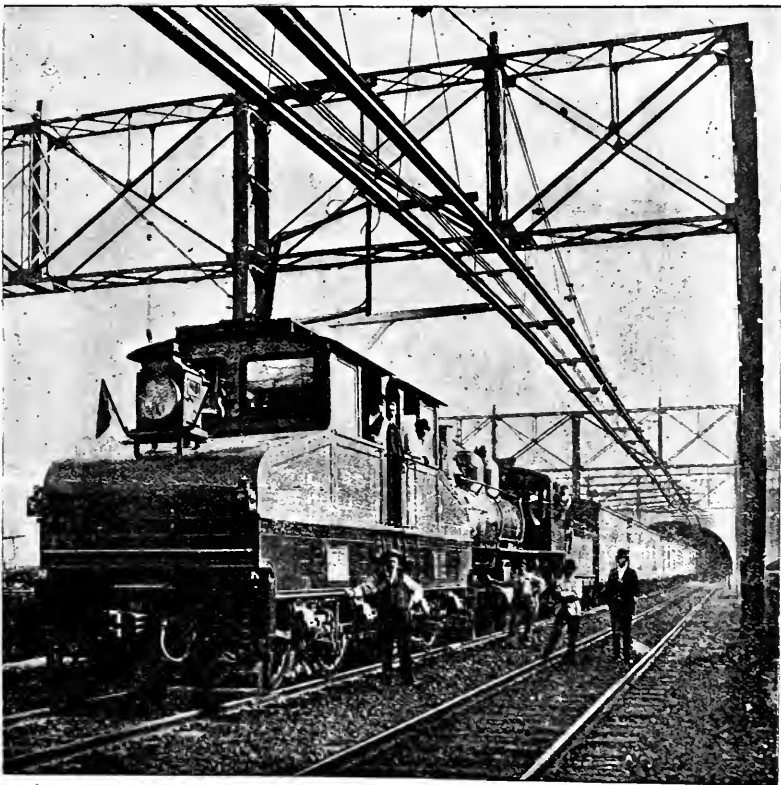
JANUARY, 1896

No. 1.

ELECTRIC FREIGHT LOCOMOTIVE.

SINCE the month of August last a 96-ton electric locomotive has been in successful operation for hauling freight on the Baltimore & Ohio railway. No interruptions whatever have occurred, the locomotive responding in every case without failure either of speed or power. Tests were made recently to ascertain its capa-

city for running a loaded train on an up-grade, in connection with which the following particulars will be of interest. The illustration presented shows the electric locomotive coupled to a north-bound freight train leaving the tunnel. The total distance moved in 40 seconds was 150 feet and at the expiration of one minute 450 feet.



ELECTRIC LOCOMOTIVE AND FREIGHT TRAIN LEAVING TUNNEL ON THE BALTIMORE & OHIO RAILWAY.

city for running a loaded train on an up-grade, in connection with which the following particulars will be of interest. The illustration presented shows the electric locomotive coupled to a north-bound freight train leaving the tunnel.

A train consisting of two steam locomotives, not working, and 27 loaded freight cars, was brought to a stop, while going north through the tunnel. Here the grade is 42 feet to the mile, and the rails were damp and greasy. The weight of the train was 1,125 tons, or 1,221 including the electric locomotive. Every drawbar was tight, no slack occurring throughout the length

Another test was made with a dynamometer car placed between the electric locomotive and the train, which consisted of 22 cars loaded with coal, one caboose and two dead locomotives. The total weight was 1,008 tons. On the 10 per cent. grade in the tunnel an average drawbar pull of some 25,000 pounds was obtained from the dynamometer diagram. The speed at this point was 11 $\frac{1}{8}$ miles per hour. Comparison with the diagrams obtained in similar service with steam locomotives showed a remarkably uniform and steady pull by the electric engine, due to the absence from it of reciprocating parts, the torque being

constant throughout the entire revolution of the wheel.

A further test was made with another train, consisting of 36 cars, one caboose and three dead engines. This was a regular through freight train with a local freight attached, and the total weight was in excess of 1,600 tons. It was hauled with ease through the tunnel, and calculations from the previous dynamometer records and the drawbar pull per ampere showed a drawbar pull of over 45,000 pounds.

On October 6th still another test was made, the character of the performance being heightened by the fact that the train which it moved measured over 1,800 feet in length and weighed about 1,000 tons, and was started from rest in the tunnel. It consisted of a north-bound freight train of 28 loaded cars and two locomotives coupled to a local freight of 15 loaded cars and one locomotive. In starting not a sputter, spark or slip of the wheel occurred, and the train moved with the same precision as if the circumstances had been of the ordinary character. The drawbar pull of 60,000 pounds was about the record in this case. The train was quickly brought to a speed of 12 miles an hour and pulled through the tunnel without difficulty, with the locomotive continuously exerting a drawbar pull of 40,000 pounds.

The above tests only show approximately what the locomotive can do, as its capacity has by no means been reached.

Two additional machines have been ordered by the Baltimore & Ohio Railway Company, which are now nearing completion at the works of the General Electric Company at Schenectady.

A CANADIAN'S RIDE ON THE WINNING MOTO-CYCLE.

WHILE so much has been said lately of the moto-cycle or horseless carriage we thought a description of a ride on one in the late Chicago race would be of interest to our readers.

One of our representatives called on Arthur W. White, of London, Ont., of the firm of Geo. White & Sons, well known manufacturers of engines, boilers, etc., he being the only Canadian official in the Chicago road race last (U. S.) Thanksgiving Day. He and his father, Geo. White, were in Chicago for ten days before the race, during the preliminary tests.

On the morning of the race the umpires were assigned to the carriages, one to each. Arthur W. White was placed on the Duryea carriage, he not knowing till then which carriage he was to ride in. The route of sixty miles ran north from the corner of Michigan ave. and Rush street through Lincoln Park, then by way of Kenmore ave. to Evenston, a distance of thirty miles. The return run was from North Clark street and Belmont ave. to Milwaukee ave., then through Park Drive and Humbolt, Garfield, Douglass and Brighton parks, then down Western ave., 55th st. Boulevard, through Washington Park to starting point, the round trip being 60 miles.

With Mr. White on the carriage was Frank Duryea, the operator, brother of the inventor, Chas. E. Duryea. The day was fine overhead, but the roads were full of slush, which impeded the speed of the carriages. In some places the slush was six inches deep and often hid ruts, into one of which the Duryea carriage went at the corner of Erie and Rush streets, breaking the steering

While they were examining the extent of the

break, the Macey carriage passed them. It being a holiday, none of the blacksmith shops were open, but they hunted up a key to a shop, went in and did the work themselves. Fifty-five minutes were lost here. It took them from 8:55 a.m. to 12:45 p.m. to run to Evenston, a suburb of Chicago, making a stop of seven minutes before reaching Evenston for water. Shortly after getting water they caught up to the Macey carriage. The road here was but one broken track, with snow on each side to the depth of from six to eight inches. One of the rules of the contest was that if the leading carriage could not prove its capability to keep ahead, it was compelled to pull out and let the other go by. Mr. White asked them to comply with the rules, which the Macey people did. He was sorry to ask them to do it, but the rules had to be complied with. A short way south of Evenston a sleigh load of young people upset while turning a corner, but Mr. Duryea brought the carriage to a standstill almost instantly, just as the wheels touched the horses. The carriage at this time was going twelve miles an hour. At the corner of Clark and Lawrence ave. they lost their way, and went two miles out of the course. At Diversea street part of the mechanism broke, which necessitated the drawing out of a piece of inch ground steel; this was done in a tinsmith shop with the aid of a charcoal fire and tinsmith's hammers. They had to light the fire, and lost one hour here. Through the west side parks the snow was very deep, and to use a slang term, "the woods were full" of boys who made Messrs. White & Duryea targets for their snow balls. Mr. Duryea received "one in the neck" which dazed him. Two policemen tried to control the boys, but the boys didn't see it that way, and utterly routed the cops. Crowds lined the route and many were the cheers our friends received. The Kodak fiend, as on all occasions, was on hand—you saw him in every guise, in every place, at all times. One fiend got down on his back in the slush under the Duryea carriage to take a snap at the mechanism. The Duryea rig reached the starting point again at 7:18 p.m., being 10 hours and twenty-three minutes on the road, and winning the race. The Muller carriage came in a little above an hour afterwards. The Macey carriage became mixed up with a trolley car and did not get in till the next day.

After the race Mr. Hewitt, president of the company who will manufacture the Duryea carriage in Springfield, Mass., entertained the Duryea people and Mr. White and friends to supper, which was quite acceptable to Mr. Arthur W. White and Mr. Frank Duryea, as they had had nothing to eat since 6:30 a.m.

Mr. Arthur W. White is building an electro-moto-cycle in London, and will give it a test at the proposed races in that city on the 24th of May next. He is very desirous that a moto-cycle test should take place in Canada this year, and suggests that London, being surrounded in all directions by excellent roads, would be the most suitable place for such an event. The horseless carriage has a great future before it. The thing to be decided is what power will be the best for all occasions.

Mr. E. Lusher, Secretary of the Montreal Street Railway, has recovered from his recent illness.

A. E. Payne, a well-known electrician of Boston, Mass., has decided to make his home in Canada, and has joined the Royal Electric Company at Toronto.

COMBUSTION.*

By THOMAS WENDEY, OTTAWA.

(Concluded.)

I will here give you an approximate list of square feet of heating surface per horse-power in different styles of boilers, and various other data for comparison:

TYPE OF BOILER.	Square feet of heating surface for one horse-power.	Coal per square foot per hour.	Relative Economy.	Relative Rapidity of Steaming.	AUTHORITY.
Water Tube.....	10 to 12	.3	1.00	1.00	Isherwood.
Tubular.....	14 to 18	.25	.91	.50	"
Flue.....	8 to 12	.4	.79	.25	Prof. Trowbridge
Plain Cylinder.....	6 to 10	.5	.69	.20	
Locomotive.....	12 to 16	.275	.85	.55	
Vertical Tubular..	15 to 20	.25	.80	.60	

A horse-power in a steam engine or other prime mover is 550 foot lbs. raised one foot per second, or 33,000 lbs. one foot per minute.

In Engineering of August 17th, 1894, there is a report of two tests made with a triple expansion mill engine of 1,000 horse-power, built by Victor Coates & Co., limited, of Belfast, for the spinning mills of the Brookfield Linen Company, limited, of the same city. This engine was set to work on the 18th of September, 1893, and has been at work ever since, giving satisfactory results, especially in the matter of fuel consumption and steady driving. As shown by these tests, the amount of water used is remarkably small, being 11.5 lbs. per hourly horse-power, and the coal consumption was 1 lb. The diameters of the cylinders are respectively 16, 20 and 46 inches, with a stroke of 48 inches. The steam was generated in two Lancashire boilers, 7 feet 6 inches in diameter and 30 feet long; each boiler has two furnaces of the Adamson type, having five Galloway tubes in each, and the total heating surface of the two boilers is 1,900 square feet. On these tests the engines were not running at full power, but were developing 787.4 horse-power, so that the heating surface per horse-power in this case was 2.41 square feet. The feed water was heated in the economiser to 250° Fahrenheit, and if we include the heating surface of the economiser, 3,600 square feet, there would be a total of 5,500, or 7.112 square feet per horse-power. The economiser is placed in the base of the chimney, and the feed water is heated by the hot gases which are passing away to the atmosphere, and would otherwise be a total loss.

When anthracite or hard coal is used, there should be from 22 to 24 inches between the top of the bars and the lowest part of the boiler. If bituminous or soft coal is used, then from 27 to 30 inches.

It is an absolute condition of economy and efficiency that the grate bars shall at all times be well and evenly covered with the fuel, but this condition is one that is frequently neglected. If the bars are not uniformly and evenly covered, the air enters irregularly in streams, passing through the thinnest or uncovered parts; if too thickly covered it prevents the air entering. You all know that the thickness of the fire will depend upon the size of the coal used. The smaller the fuel the thinner the fire. With egg coal from 6 to 8 inches, and with furnace coal from 8 to 10 inches have been found the best results in practice. In burning soft coal the charges should be light, as the gases which are evolved will have a better opportunity of getting the requisite quantity of oxygen.

I have seen from 15 to 16 inches of coal on the bars at a time, and upon asking the fireman his reasons for having such a heavy fire, his answer has been that he could not get steam unless he had that quantity. It is argued by some that it is necessary, when a boiler is worked to a high rate of capacity, to maintain heavy fires, and that thin fires are well enough for slow rates of combustion; but when the call for steam increases, it must be met by an increased thickness in the bed of coal on the grate. The ordinary fireman is apt to favor this method, for the reason that he can introduce large quantities at a firing, and afterward he is not obliged to give the fires much attention, for perhaps an hour's time, when he will again fill the furnace full in the same manner as before. As an explanation, however, of the favor which this method receives, it is probable that the class of labor which is generally employed considers the muscular effort required much less of a task than the more frequent and careful attention which is needed when the fires are thin. Under such conditions it is almost impossible to regulate with natural draught the supply of air, upon which we must depend entirely for perfect combustion and economy.

As regards a comparison between thick and thin fires, the fact is that more capacity can be obtained from a boiler when a fire of medium thickness is carried and proper attention is given to its condition, than can be realized by any system of management when the fires are exceedingly heavy, and advocates of thick fires, who take the ground that they are a necessity, are mistaken. As to the economy of the two, some persons maintain that heavy fires give the most economical results, but this is questionable. Valuable information on the subject has recently been brought out by the results of two evaporative tests which were made on a 72-in return tubular boiler, having one hundred 3½ inch tubes, 17 feet in length. The heating surface amounted to 1,642 square feet, and the grate surface to 36 square feet, the ratio of the two being 45.6 to 1. On the thick fire test, the depth of coal on the grate varied from 10 to 20 inches, being heaviest at the rear end and lightest at the front end. On the thin fire test, the depth was maintained uniformly at about 6 inches. The coal was Kew River semi-bituminous coal. The difference in the results, as appears from the figures, is an increased evaporation due to their fires amounting to 15.6 per cent.

The quantity of heat generated in the furnace is dependent on the relative weight of hydrogen first, and carbon afterwards, chemically combined with their equivalent weights of atmospheric oxygen. If chemistry did not teach us this, our daily experience would soon convince us.

In using soft or bituminous coal, which contains a large percentage of volatile matter, it is necessary to introduce air over the fuel (unless we are working with the forced draught system), as we cannot get sufficient air through the grates, and that which comes is loaded with carbon which it has picked up in its passage through the fire. For this purpose we have apertures in the doors, or we leave the door ajar after a new charge of coal. You will readily perceive that the admission of any large quantity of air in this way must be objectionable, as it will cool the gases below the point of ignition, and if too much is admitted it will carry off heat from the furnace. There are a number of ways of admitting air to better advantage; the simplest is to conduct the air through a hollow bridge wall and discharge it through apertures in the top, the air mingling with the lower strata of the burning gases as they pass over the bridge, thus ensuring a more perfect combustion.

George W. Barrus, M.E., made tests with a boiler where provision had been made for the admission of air as above, with Cumberland, anthracite and a mixture of two parts pea and dust, and one part Cumberland. In the case of the Cumberland, the evaporation was increased about six per cent.; with the anthracite, the evaporation was decreased about one per cent. The hot air completed the combustion of the volatile products of the soft coal, which would otherwise escape unburned. The slower burning anthracite did not need this supply and did better without it. The effect which the introduction of air had upon the appearance of the products of combustion, as viewed from the "peek hole" crack of the bridge wall, was very noticeable in both cases, but greatest with the soft coal; but Mr. Barrus says that there was a heightened color and increased activity to the flame, whichever fuel was used, notwithstanding the average evaporative result with the hard coal was lower. Mr. Barrus' conclusion, drawn from many tests, is that a considerable advantage attends the admission of air above the fuel when bituminous coal is employed, but that there is no advantage when mixtures of anthracite screenings and bituminous coal are used, and little or no benefit is derived when anthracite coal is used.

The importance of good draught, natural or mechanical, for the supplying of sufficient oxygen for the rapid and economical combustion of fuel, has long been felt by the engineer. The gain both in capacity and efficiency which would be obtained by the rapid and energetic combustion of the various kinds of coal, and the high furnace temperature resulting therefrom, is well established, but its importance has only been admitted within the last few years. High initial furnace temperature is essential with all kinds of boilers to obtain the greatest economy, and to obtain this high temperature requires proper draught to deliver an abundant supply of oxygen to the furnace. This result is obtained by natural draught in a well-proportioned chimney, or forced draught obtained by mechanically creating a pressure under the grates with a fan or blower. The advantages of the forced draught are: 1st. It is under complete control. 2nd. The more perfect combustion of fuel by reason of the more abundant supply of oxygen to the furnace, and the possibility of using a cheaper grade of coal, with a proper combustion of the same. It

* A paper read before the Canadian Association of Stationary Engineers.

is a fact, however, that the most perfect plant will be a failure if the firing of the boilers is not properly attended to, and the fires kept at an even and uniform thickness suitable to the grade of coal used, and it is to be regretted that so little attention is paid to this fact.

There is a furnace in use in the United States, a sketch of which I submit herewith, and known as the Hawley Down-Draught Smoke-Consuming Furnace. The characteristic features of the Hawley setting will be of interest; it consists of a double set of grate bars, one above the other; the upper, or water grate, is made of 2-inch pipe, screwed into headers, or drums, connected with the circulating system of the boiler. The supply pipes to the front header are taken from near the bottom of the front end of the shell, the water passing through the grates into the rear header, which is connected to the boiler shell some distance back from the front, just below the water line, and the space between the drum and shell is built up solid with fire-brick. The operation of the down-draught furnace is directly opposite to that of the ordinary setting. Comparatively little air is admitted below the water grates, and the entire supply of coal, and practically all the air enters above. The fire burns downward, instead of upward, there being no passage except downward through the grates. The gaseous products of combustion, together with the finely divided carbon particles which form the visible smoke, are forced through the incandescent mass of coals and are highly heated, after which they meet the equally hot flame from the lower grate, on which there is burning what is practically a coke fire. The combined water of the volatile matter in the coal, as well as its moisture, are decomposed into hydrogen and carbonic oxide gases, and these combine with the air supplied below the grate, or drawn downward through it, and burn, thus adding to the efficiency of the furnace. The separated carbon meanwhile is transformed into carbonic acid gas, and the result is almost complete combustion. Whatever additional air is required is furnished through registers in the doors between the two grates, or through those of the ash pit. The style of furnace requires a somewhat increased chimney capacity, if it is desired that the boilers be capable of doing as much work as those set in the ordinary way. If the demand for steam never greatly exceeds the rated capacity of the boiler, the ordinary chimney will answer, it simply being necessary to carry thinner fires. The best results, however, in efficiency and smokelessness, as well as in capacity, are secured by having a chimney of ample height, but this is equally true with regard to ordinary settings, which rarely have enough chimney. They claim a saving for this furnace of from 20 to 30 per cent.

The highest value that has been found by actual test of a pound of coal is 14,603 heat units, and each heat unit is equivalent to 778 foot pounds, so that each pound of coal furnishes the equivalent of 11,361.134 foot pounds per hour, but we only get back 1,080,000 foot pounds, or about one-sixth of the mechanical equivalent of the heat supplied.

A pound of coal or any other fuel has a definite heat-producing capacity, and is capable of evaporating a definite quantity of water under given conditions; this is a limit beyond which even perfection cannot go, and yet, I have heard, and doubtless you have heard, of cases where inventors have claimed that their improvements will enable you to evaporate from 16 to 17 pounds of water per pound of coal, and so-called engineers have certified to these results.

You all know that this is impossible, the highest value for a pound of coal being 14,603 heat units, and it is a known fact that it takes 965.7 heat units to evaporate one pound of water from and at 212° Fahrenheit, so that dividing 14,603 by 965.7 we have 15.1 pounds of water per pound of coal, and then only when every heat unit is put into the water. The highest value of evaporation so far has been 11.5 pounds of water per pound of coal, per hour; but, as a general rule, it is from 7½ to 8 pounds per pound of coal, per hour.

In conclusion, I would say that in the combustion of fuel there is but one body combustible to be dealt with, carbon and hydrogen, and but one supporter, the oxygen of the air; that in combustion, atmospheric air is the principal element, but it is the one to which practically the least attention is given, either as to quantity or control, and that chemistry and experience teach us that combustion depends, not so much on the quantity of air passing through the incandescent fuel, as upon the weight of oxygen taken up in its passage through it. In fact, the quantity of air passing through it may be destructive of combustion if improperly introduced and distributed. That the quantity of heat generated

depends upon the relative weight of carbon or hydrogen, and chemically considered, their equivalent weights of atmospheric oxygen, so also the quantity of steam generated does not depend so much upon the intensity of the fire as on the quantity of heat absorbed by the water. Now, it is well known that success in generating the most heat and steam, and consequently power, from a given amount of coal, depends upon a compliance with the necessary conditions to perfect combustion, which involves not only a theoretical knowledge of chemistry, but also a practical knowledge of the best methods of combining them with mechanical appliances, and the perfect mixing of the constituent elements with which we have to deal, in strict accordance with the laws of nature.

For the standard method of testing coal referred to in this paper, the following is the outline of procedure: For the moisture a finely ground sample is dried for one hour in an air bath at 105° to 110° C. For the other constituents a fresh sample is taken of about a gram in quantity and put in a platinum crucible, the crucible being covered; it is now heated for 3½ minutes over a Bunsen burner, followed immediately with the highest temperature of the blast lamp for an equal length of time. The loss in weight, less the moisture obtained, equals the volatile combustible matter. The fixed carbon is next burned off by removing the crucible cover and heating in the flames of the Bunsen burner, with access of air till the carbon is burned off; the loss of weight equals the carbon, the residue is ash.

THE LAW AS TO SUNDAY CARS.

FOLLOWING is the decision in full handed down by Judge Rose in the action brought by the Lord's Day Alliance to restrain the Hamilton Street Railway Company from running their cars on Sunday:—

"It was conceded that the defendant company had the right to run its cars on Sunday as well as on the other days of the week, unless doing so was a violation of the provisions of chap. 203, R.S.O., amending an Act to prevent the profanation of the Lord's Day, sometimes called the Lord's Day Act.

The following questions then arise: (1) Does the above statute apply to the defendant company?

(2) If so, is what was shown to have been done here within the exception as being a conveying of travellers?

(3) If not within the exception, was it necessary, to entitle the plaintiff to succeed, for him to show substantial injury to the public?

(4) If necessary, has such injury been shown?

(5) And in any view, on this evidence, is an order of injunction the proper remedy for a violation of the Act?

The statute does not apply to the company unless it is one of the persons named in the first section of the Act or a person *ejusdem generis* with those named.

I assume that the fact that the defendant is a corporation does not prevent the Act applying.

The persons named in the Act are "Merchant, tradesman, artificer, mechanic, workman, laborer, or other person whatsoever."

It is not open on the decisions in our own courts for the plaintiff to contend that the words "or other persons whatsoever" are not to be construed to refer to persons *ejusdem generis*. Therefore we have to see if a person running street cars is one named by the statute or *ejusdem generis* with such person. This question also is, as it seems to me, practically concluded by authority.

In *Sandiman v. Breach*, 7 B. & C. 96, it was held by the court, the judgment being delivered by Lord Tenterden, C.J., that the words "or other person or persons whatsoever" in the 29 Car., 2, c. 7, s. 1, were not used in a sense large enough to include the owner or driver of a stage coach; that section provided "that no tradesman, artificer, workman, laborer or other person whatsoever shall do or exercise any worldly labor, business or work of their ordinary callings on the Lord's Day," etc. In *Reg. v. Budway* (supra), it was held by the full court (Q.B.D.) that a cab driver did not come within the words of chap. 203, and in *Reg. v. Somers* (supra) the same court followed its decision in *Reg. v. Budway*.

In the latter case the fact stated was that "The defendant was a servant of one Charles Brown, a keeper of a livery stable in the city of Toronto, and on the day in question drove a cab belonging to Brown through the streets of the city for hire." Mr. Moss urged that the two latter decisions should be confined to the facts then before the court, and did not apply to a case of a cab driver who was both owner and driver. It seems to me there is in principle no distinction between the driver who is the owner and the driver who is the servant of the owner that would apply in favor of the servant, indeed it might be contended that a servant who was the owner would more readily come within the description "workman or laborer" than would the owner who was also the driver, and in *Sandiman v. Breach*, as we have seen, Lord Tenterden draws no such distinction, but uses the words "owner or driver." Then if an owner or driver of a stage coach or an owner or driver of a cab is not within the Act, is one who is an owner or driver of a street car, whether such car is by horses, steam, electricity or other motive power? I am unable to see any distinction between such persons. I think there is none; and, following the above decisions, which are binding upon me, I must hold that the defendant company is not within the Act and so not prohibited from running its cars on Sunday.

But, assuming that the act does apply, then has it been shown that the company was or was not "conveying travellers"?

The exception is in the following words: "Conveying travellers or Her Majesty's mail by land or water, selling drugs or medicines and other works of necessity, and works of charity only excepted."

In *Reg. v. Daggett*, 1 O.R., 537, the full court (Q. B. D.) composed of Hagarty, C.J., and Armour and Cameron, J.J., held that excursionists leaving Buffalo in the State of New York on a Sunday morning and proceeding by rail to Niagara, thence by defendant's steamboat to Toronto, and back the same day, were travellers within the exception, and that there is no distinction in such a case between travellers for

pleasure and for business. The decisions under the 29th Car., s. 7, were collected and referred to and accepted as defining the term "travelers" as used in our statute.

There the learned Chief Justice said: "It matters nothing in my judgment whether they travel wholly for pleasure, fresh air, relaxation from work, or with or without luggage, or actually on important business. They are travelers within the meaning of the statute. To draw any distinction between persons according to the purpose which induced them to travel would, as it seems to me, be a vain attempt, leading to impossible and irritating inquiries and tending to bring a useful and salutary enactment into contempt."

No effect was given to the argument of counsel that "conveying travelers" to be within the exception must be a work of necessity, the court evidently holding otherwise.

Among the cases referred to decided in England under the 26th Car., 2, was *Pepelow v. Richardson*, L.R., 4 C.P., 168, where it was held that a man who walked two and a half miles from his residence to drink mineral water at spa was a traveler, and in *Taylor v. Humphries*, 10 C.B., N.S., 429, *Erie, C.J.*, held that persons who had walked four miles on business or pleasure might be lawfully supplied with refreshment as travelers.

Mr. Moss endeavored to distinguish these cases on the ground that the persons had walked to a distance out of the town where they resided, but I find no distinction suggested, and it seems to me to be fanciful and not entitled to prevail. It is also manifest that the distance passed over does not determine whether one is a traveler or not.

In *Reg. v. Daggett*; *Reg. v. Tinning*, 11 U.C.R., 636, was referred to and not followed. It was declared to be not in accordance with the subsequent decisions.

In *Reg. v. Tinning* it was held that persons making their ordinary business to ply within the harbors of a town not for any purpose of carrying travelers or the mail were intended to be restrained by the Act, adding, "We think it clear that the persons carried on a Sunday between the city (Toronto) and the peninsula cannot be called travelers within the meaning of the exception. They are persons notoriously seeking mere recreation."

I must follow *Reg. v. Daggett* in preference to *Reg. v. Tinning*, leaving an appellate tribunal to say that the later decision is wrong, if it is so, for *Reg. v. Daggett* is founded upon decisions subsequent to *Reg. v. Tinning*, and has remained unquestioned since it was decided in 1852.

Both decisions are of the same court, differently constituted, and the later decision is, as I think, a declaration that the former is not good law, and is a declaration of the law which binds me sitting as a judge of first instance. It is pointed out that the Legislature by the 43 Vic. Stat., ch. 44, ss. 1-7 (now s. 7, R.S.O., c. 203), had declared excursionists not to be travelers; but it will be observed that such section applies only to persons going and returning on the same day, by the same steamboat or railway or any other mode by land or water, or by the same conveyance, such steamboat or railway having for the only or principal object the carriage of Sunday passengers for amusement or pleasure only, and does not apply to persons carried one way only or going and returning on different days. So the construction put upon the word "travelers" by the court in *Reg. v. Daggett* stands with the above exception.

It is instructive to note the care the Legislature exercised in declaring the limitations to such extension of the Act.

I find as a fact the defendant company has not been shown to have run its cars having for the principal or only object the carriage of Sunday passengers for amusement or pleasure only, and there is no evidence before me on which I could find that the company carried what might be called Sunday excursionists.

I find as a fact that the cars of the defendant company were shown to have been run on Sunday as on other days, only less frequently, for the carriage of travelers at the usual rate of fare, and, although it may be that persons who were not travelers were carried, such fact was not shown. It having been decided that to go two and a half miles to drink mineral waters; to walk out for fresh air, or pleasure, say three or four miles; to go upon an excursion from Buffalo to Toronto and return; or to go over to the peninsula, (now Island) opposite Toronto for recreation, constituted the person so journeying a traveler, I must either ignore the effect of such decisions or hold that at least certain persons carried by the defendant company were travelers within the meaning of the Act, e.g., persons who were coming into the city by the ordinary railway trains, desired to reach their respective destinations in the city; persons going to and returning from church; persons going to places of rest or recreation; and the like.

It follows, from the view I have taken of the decision referred to, that the company had a right to run its cars for the purpose of "conveying travelers," and, so running, the cars would create all the noise and disturbance that they are alleged to create, to the annoyance of some of the persons who gave evidence at the trial, without regard to whether or not they carry persons who are coming into the city. I cannot find that, by carrying persons who were not travelers, they have created or continued a nuisance, therefore, there is no ground on which the court can interfere.

For the information of the court, if this case is carried farther, and it shall become necessary to find upon the evidence found by me, I desire to say that, as far as I could judge, the several witnesses at the trial were apparently honest in their endeavor to tell the truth. Their opinions as to the running of the cars on Sunday being an annoyance seemed to be affected by their views as to whether it was morally right or wrong as to the running of the cars, and such views were again influenced to some extent by the fact that the running of the cars on Sunday was or was not to them or the churches or congregations to which they belonged a benefit, advantage, or convenience.

I was referred by Mr. Martin to ch. 99 of the 55 Vic. (O.), incorporating the Toronto Railway Company, and confirming the agreement therein set out. By clause 1 of the Act the company is permitted to run its cars on Sunday, when agreed to by the citizens, provided that so doing it is not a contravention of the Lord's Day Act. This probably means that the Legislature had formed no opinion that the Lord's Day Act did clearly prohibit the running of cars on Sunday.

I was referred to the case of *The Attorney-General v. Niagara Falls Tramway Co.*, 10 O.R., 624, and 18 A.R., 453, but that case did not turn upon any question under chap. 203, above considered.

On the whole, I am of the opinion that the plaintiff's case fails, and the action must be dismissed with costs.

THE STEAM ENGINE INDICATOR AND ITS USES.

By WM. THOMPSON, CHIEF ENGINEER MONTREAL WEST WATER & LIGHT STATION.

YEAR after year the beneficial results to be derived from this wonderful little instrument become more widely known throughout the engineering profession, and the study of indicator diagrams is now easy as compared with a few years ago, owing to the completeness and simplicity of the data at hand. But all engineers are unfortunately not in a position to either acquire a theoretical or practical acquaintance with the indicator, and to these I more especially desire to address myself. In these days of progressive modern engineering nearly every plant of any importance is provided with either one or more indicators for the use of its engineers. Owners of small plants, however, very rarely consider this instrument a necessity, as they rarely understand the purpose for which it is intended. The engineers in charge of these plants have therefore very little chance to become acquainted with the use of the indicator practically unless they put their hands in their pockets and purchase one for themselves, a course I strongly advise even though you may have to reduce your spending money for some time and go "hard up" for months. You will derive such knowledge from the use and study of this instru-

ment, that no matter how thoroughly practical you may be, you will be so fully repaid that the outlay will never be regretted. An engineer aspiring to perfect himself in his profession loves to study the theoretical basis of his profession and to acquire such intimate knowledge that every move of his engine is thoroughly understood, and becomes to him at least a thing of pride and joy, always scrupulously clean and running as smoothly as care and knowledge can make it, satisfying to both engineer and employer. To an engineer of this type (and I know many of them) I say buy yourself an indicator rather than a watch to show you when it becomes time to quit work for the day. If an engineer of the opposite type, an indicator will not be of much use, as it will almost surely soon get so badly out of twist as the engine you so often claim is of no earthly use except for scrap iron. To practical men studying their own and their employer's interests the indicator becomes almost a necessity.

Some of the leading and most valuable items to be obtained by the use of the indicator are:

(1) The arrangement of the valves for admission cut-off, release and compression of the steam.

(2) The adequacy of the ports and passages for admission and exhaust, and, when applied to the steam chest, the adequacy of the steam pipes.

(3) The suitability of the valve motion in point of rapidity at the right time.

(4) The quantity of power developed in the cylinder and the quantity lost in various ways, viz., by wire drawing, by back pressure, by premature release, by poor adjustment of valves, by leakage, etc.

Taken in combination with measurement of feed water and the condensation and measurement of the exhaust steam with the amount of fuel used, the indicator furnishes many other items of valuable information obtainable from no other source when the economical generation and use of steam are considered. The latter question is annually becoming of greater importance, not only to proprietors, but to the engineer. I do not for a moment claim that because your valves were set without the aid of an indicator that they are sure to be wrong, but I do say that with the intelligent use of an indicator you can readily ascertain if they are exactly right, and you can ascertain just how much power you are using and just how much is useful and how much is frictional; in other words, you have at all times the means to ascertain what you are doing and how you are doing it.

I have heard men boast time and again that they could set the most complicated valve systems without the aid of an indicator, and I have had the pleasure of indicating some of these engines and invariably found a great improvement could easily be effected, simply because the means were at hand to ascertain if any errors existed, and not because of any want of ability on the part of the engineer.

Having decided to own an indicator, the purchase of the instrument becomes a question requiring careful consideration. In the first place, indicators can be had at almost any price, but the nature of the work required on a good reliable instrument is so minute that only the very best work and materials must be employed, that you will find it to your advantage to deal with a maker having a reliable reputation for good goods rather than purchasing a poor instrument at a cheaper price. Any instrument can be made to work, but not all the instruments sold will do good work. You might as well expect to secure a really reliable engineer at half wages as to buy a good and reliable instrument at half what it is worth. The nature and style of work you have to do will very largely determine the style of instrument to purchase; for instance, you can use an instrument of much heavier make on a slow running engine than on an engine running at high speed and changing direction of paper drum travel more rapidly. Modern constructed indicators are now arranged bearing particularly on high speeds, and it is generally advisable to purchase an instrument designed for high speeds, which will be quite as useful on the average slow speed engine.

The importance of the indicator is now so generally recognized by all engine builders that nearly all first-class engines are sent from the shops with the cylinders already drilled for application. When, however, no provision has been made for the application of the indicator, holes must be drilled and tapped for not less than $\frac{1}{2}$ inch pipe in such position on the cylinder that when the piston is at the ends of its travel they will be as nearly as possible in the center of the clearance space, and yet not be obstructed by the piston when at its extremes of travel. In drilling great care must be taken not to allow any chips to get into the cylinder; and when the cylinder heads cannot be removed it is best to turn on a little steam as the drill begins to enter, so as to blow all cuttings out. If you find clearance is too small to allow connection as above, the tap may be made directly into the head (which it is desirable to avoid if at all possible) to bring the indicator into a convenient position, the object being to have the indicator connected as directly as possible to the cylinder, and in all cases where the circumstances will permit screw the indicator cock into the cylinder itself. Where the tap is on the side of the cylinder, by use of nipples and elbows the indicator can be brought into a vertical position the same as if tapped on top of cylinder. When the arrangement is to be permanent, it is advisable to have a cock for each end of the cylinder. Where you are using only one instrument, the best method being to connect by means of side pipes and a 3 way cock arranged exactly in center of cylinder. The slight disadvantage arising from this indirect connection is more than counterbalanced by the facility with which diagrams can be taken without disturbing the paper drum, and by the fact that diagrams can be taken from both ends of the cylinder on the same card, making them very useful for comparison. Do not, if possible, to avoid this, use angle valves on the ends of pipe instead

of elbows with a T in the centre to attach indicator to, as in some times done, or the diagrams are liable to present an appearance similar to insufficient lead and "wire drawn" admission.

After cylinder is ready for application of indicator, the next step is to prepare a suitable reducing motion to get the required length of diagram on the paper drum. This is sometimes difficult to do, particularly when high rates of speed are used. There are certain important points to observe, the chief requisite that the device used shall give to the paper drum a motion which will exactly coincide with position of piston in miniature at any part of stroke. The most reliable and useful device I have had the pleasure of using for this purpose is the recent invention of a well known Canadian engineer, Capt. James Wright, of Montreal, and illustrated in the ELECTRICAL NEWS of April 1895. As my readers can easily get a full description of this device by referring to their back numbers, I need not here describe it.

In setting this reducer upon an engine permanently, it is well to commence mechanically and as near correct as possible. Lay out reducing motion so that when piston is in center of travel, vertical lever of reducer is exactly at right angles with piston rod and as near center of cross-head as circumstances and nature of construction of engine will permit. It is also important that sliding bar of reducer should at all times travel parallel with cross head of engine. With ordinary care in setting up this reducer can be made to appear a portion of the engine and will actuate the revolving drum of indicator practically correct at almost any rate of speed, and paper drum can be attached or detached at will of operator without any difficulty.

To take a diagram, screw the indicator to 3 way cock already placed in center of cylinder, and connect with sliding guide on reducing motion by means of cord having as little stretch as possible. If distance from indicator to paper drum is very great, it is better to use a piece of flexible wire for this purpose. Both wire and cord must be provided with a hook and loop, so that cord can be detached at will with engine in motion. Adjust sliding bar of reducer to required length of diagram by means of movable fulcrum pin in frame. For slow speeds the best and most desirable diagram is from $3\frac{1}{2}$ to 4 inches in length, but with high speeds for accuracy diagrams should not be more than about 3 inches. If spring on paper drum is properly set the length of card can be adjusted to a nicety, and an effort should always be made to have length as free from fractions as possible to simplify and assist after calculations of diagrams.

To attach a card to paper drum is a simple matter, but I should strongly advise the use of metallic faced paper to allow use of a metallic point on end of pencil lever, which must be firmly and securely fastened to prevent any possible vibration through shaking or moving of pencil, also the friction should be as light as possible and a very fine line drawn with merest touch of point on paper.

In selecting a spring always use one that will give you a diagram about 2 inches high, that is with a No. 10 boiler pressure use a 40 spring. Each indicator usually has from 3 to 5 springs accompanying it. Before allowing steam to enter indicator remove piston from indicator cylinder and blow steam through from both ends of engine cylinder. Carefully oil indicator piston with best cylinder oil, and all other moving parts with specially prepared watch oil. An indicator piston should drop into cylinder of its own weight freely and easily, when both ends are open to the atmosphere. Screw down milled nut on indicator firmly and adjust screw to regulate pressure of pencil, keeping pressure as light as possible, and be careful to have paper securely and smoothly placed on revolving drum.

Before allowing full pressure steam to enter indicator allow steam to escape on relief valve at side of 3 way cock until steam becomes dry and clean. Allow indicator piston to work under full pressure for a few revolutions, until it becomes hot, then with both ends of piston open to atmosphere, draw the atmospheric line by applying pencil to paper while moving with reducing motion. Turn on steam under full pressure and apply pencil to paper during one or more revolutions of engine from each end of cylinder. If reducing motion and paper drum spring are properly adjusted, length of a double card should measure in length exactly the same as the length of the atmospheric line previously drawn.

After a sufficient number of diagrams have been taken, remove the piston, etc., from the indicator, while it is still upon the engine, allow steam to blow for a moment through the indicator cylinder, and see that piston, spring and all movable parts are thoroughly wiped, cleaned and oiled. Pay particular attention to the springs, as their accuracy will be seriously impaired if they are allowed to rust, and great care must be taken that no grit or foreign substance be introduced, to cut the cylinder or scratch the piston; remember you are handling a delicate and sensitive instrument, and act accordingly. The heat of the steam blown through the cylinder of the indicator will be found to have dried it perfectly, and the instrument may be put together with the assurance that it is ready for instant and immediate use when required.

The various lines drawn by the indicator on the diagram are named as follows and can be readily recognized after a little practice:

THE ATMOSPHERIC LINE is a line drawn by the pencil of the indicator when the connections with the engines are closed and both sides of the piston are open to the atmosphere. This line represents on the card the pressure of the atmosphere or zero gauge pressure.

THE VACUUM LINE is a reference line drawn about 14.7 pounds by scale below the atmospheric line and represents a perfect vacuum or line of no pressure.

THE CLEARANCE LINE is another reference line drawn at a distance from the end of the diagram, and at right angles with a line

here, equal to the same per cent. of its length as the clearance is of the piston displacement. The distance between the clearance line and the end of the diagram represents the volume of the clearance and waste room of the ports and passages at the end of the cylinder.

THE LINE OF BOILER PRESSURE is a reference line drawn by hand parallel to the atmospheric line and at a distance from it by scale equal to the boiler pressure shown by the gauge. The difference in pounds pressure between it and the steam line shows the loss of pressure due to steam pipe and the ports and passages on the engine.

THE ADMISSION LINE shows the rise of pressure due to the admission of steam to the cylinder by opening the steam valve. If the steam is admitted quickly when the engine is about on the dead centre this line will be practically vertical and at right angles to the atmosphere.

THE STEAM LINE is drawn when the valve is open and steam being admitted to the cylinder. In automatic cut-off engines with sufficient port area this line will be practically parallel with atmospheric pressure.

THE POINT OF CUT-OFF is the point where the admission of steam is stopped by closing the valve. Sometimes there is a little difficulty in determining just exactly where this takes place. It is usually, however, located where the outline of the diagram changes from convex to concave.

THE EXPANSION CURVE shows the fall in pressure as the steam in the cylinder expands doing work.

THE POINT OF RELEASE shows when the exhaust valve opens.

THE EXHAUST LINE represents the change in pressure that takes place when the exhaust valve opens.

THE BACK PRESSURE LINE shows the pressure against which the piston acts during its return stroke. On diagrams taken from a non-condensing engine it is either co-incident with or above the atmospheric line. On diagrams taken from a condensing engine it is found below the atmospheric line and at a distance greater or less, according to the vacuum obtained in the cylinder.

THE POINT OF EXHAUST CLOSURE is the point where the exhaust valve closes.

THE COMPRESSION CURVE shows the rise in pressure due to the compression of the steam remaining in the cylinder after the exhaust valve has closed.

THE MEAN EFFECTIVE PRESSURE (M. E. P.) is the mean net pressure pushing the piston forward.

THE INITIAL PRESSURE (I. P.) is the pressure acting on the piston at the beginning of the stroke.

THE TERMINAL PRESSURE is the pressure above the line of perfect vacuum that would exist at the end of the stroke if the steam had not been released earlier. It is found by continuing the expansion curve to the end of the diagram. This pressure is measured from the line of perfect vacuum, hence it is the absolute terminal pressure.

It is not my intention to use diagrams, I therefore will not attempt to describe how the various calculations can be arrived at by gathering particulars from diagrams. Any engineer with a little experience in handling indicators, will be able to analyse his own diagram, if not, I am quite sure the editor of this esteemed journal will be only too glad to reproduce them, together with any questions, in his paper, to allow other engineers a chance to analyse and discuss them.

The most important formulae required is that to find the horse power generated from a diagram, and this is the only one I shall take the liberty to deal with. You first require to find from the diagram the mean effective pressure on the engine piston throughout the stroke, this is easiest arrived at by the use of a small instrument called the planimeter, which with careful manipulation will give the area of the diagram within the hundredth part of an inch. When area of diagram becomes known divide by length of diagram, the result will be the mean average height of the diagram; multiply this by scale of spring used and you have the M. E. P. throughout the stroke. There are, however, several methods of finding the M. E. P. without the aid of a planimeter, one of the most convenient being as follows: Draw on the diagram ten or any other convenient number of lines at right angles to the atmospheric line and at equal distances apart. Measure the length of each ordinate within the lines of the diagram and divide the sum total of their lengths by the number of ordinates used. Multiply average length thus found as before and you have the same result.

To calculate the h. p. of an engine, multiply the mean net area of the piston in square inches, (Diameter squared $\times .7854$ = area minus area of piston rod = mean net area) by the M. E. P. previously found in pounds per square inch acting on the piston throughout the stroke (area piston \times M. E. P.). Multiply this product by the distance through which the piston travels in inches per minute. (Stroke in inches \times rev. per minute $\times 2$ strokes per revolution), this will give you the number of inch pounds exerted by the engine. Divide this by 12 to reduce to foot pounds, and as an h. p. is understood to equal 33,000 pounds raised 1 foot high in one minute, by dividing total foot pounds by 33,000 you get total h. p. generated by engine in accordance with following formula:—

$$\frac{\text{Mean net area of piston} \times \text{M. E. P.} \times \text{rev. per min.} \times 2 \times \text{stroke in inches}}{12 \times 33000} = \text{H. P.}$$

Mr. E. E. Cary, who has been engaged in the manufacture of incandescent lamps in the United States for the past ten years, has accepted the position of general manager of the Packard Electric Co., Ltd., of St. Catharines, Ont. Mr. Cary expects shortly to call upon and make the acquaintance of the many users of the Packard lamp and transformer throughout the Dominion.

CORRESPONDENCE

BOILER EXPLOSIONS AND THEIR CAUSES.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—Your theory of the Detroit boiler explosion is correct and the only commonsense one, to wit, that the safety valve, even if operative and open, was too small to give passage to vapor forming with such rapidity as to increase its pressure from 15 lbs. to 100 lbs. in four minutes, and from 50 lbs. to 100 lbs. in one minute. Until Parliament intervenes to have safety valves made larger, explosions will continue to occur and fatalities to follow.

C. BAILLAIRGE,
City Engineer, Québec.

THE C. A. S. E. AS A SECRET ORDER.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—I notice in your last issue an editorial the first three lines of which contained the following: "It seems unfortunate that the Association of Stationary Engineers should have been organized upon the basis of a fraternal order."

Since becoming a member of the above order I have been enabled through its aid to master numerous problems pertaining to the calling, but after carefully reading your article and trying to formulate a plan by which any body of men could so hold together without either sign or password, I was obliged to give it up.

If we admit that some secrecy is necessary, we must also admit that no Association could be organized with less than the C. A. S. E. You say you do not object to such societies or lodge room methods, but the cumbersome machinery of a secret society is unnecessary where there is nothing to conceal.

Mr. Editor, you must have got into the room where we keep the goat, as he is the only cumbersome piece of machinery we have, and the fact that you have taken the 4th degree and not the first three, may be responsible for the statement you made that our initiations are not always impressive.

I will impart to you some of the secrets in the following statement. Our initiation (including all the degrees) occupies about ten minutes. Engineers being a good thing, and consequently scarce, is responsible for the very few initiations during the year, say ten at most; this is about one hour and a half spent in twelve months, and I venture this remark, Sir, that the time spent by you in copying and printing the above article occupied more time, is no more legitimate, nor beneficial than the initiations, etc., of the C. A. S. E.

In conclusion I will say that as the paraphernalia of the order consists only of a tin cent brass plated button, I will not mention it. However, if it should prove unsightly to any one I will bore holes in it and utilize it instead of wire nails to keep the bottoms of my blue bloomers from sweeping the dusty surface of my boiler room.

Toronto, Dec. 12th, 1895.

J. G. BAIN.

BY THE WAY.

MR. A. W. CONGDON, now engaged in the engineering department of the Canadian General Electric Company at Toronto, was one of the pioneers in the introduction of electricity for lighting purposes in Japan. In 1889 the Edison Company, of New York, in whose employ Mr. Congdon then was, received an order from Japan for a 100 light electric plant. Partly owing to the improbability of being able to secure the services of any one competent to install the plant, and partly, no doubt, with the object of making known their goods in an entirely new field, the possibilities of which it was impossible to judge, the company decided to send Mr. Congdon and another of their employees to Japan with the electrical apparatus and the necessary steam plant to operate the same.

This was the second electric plant installed in the country, the first one having previously been put in by the Brush Company. The intention was that Mr. Congdon and his companion should remain about six months, or long enough to install the plant and get it into proper working order, and be enabled to estimate the possibi-

ties of the field for future business. As a matter of fact, the two Americans remained in Japan for a period of nearly three years. After completing the work which they were specially sent out to do they received an order to install an arc and incandescent system for the Emperor, whose palace is now lighted with incandescent lamps, and the grounds surrounding it with arc lights.

Mr. Congdon states that, owing to the prejudice which prevails against foreigners, all business in Japan has to be done through native companies. Such companies now exist in Tokio and several of the other large cities, and it is estimated that there are at present in operation throughout the empire about 16,000 lights.

Public lighting is done by these companies under contract with the municipality and with private consumers in the same manner as in this country. Much of the current to private consumers is supplied through meters, an additional charge being paid by the customer for the use of the meter. Lighting plants are also being put in to some extent by manufacturing companies. For one cotton mill company Mr. Congdon installed a 500 light plant, which has since been increased to 1000 lights.

On account of the low standard of illumination, as compared with Europe and America, the progress of electricity for lighting has necessarily been slow. The people of Japan cannot be expected to jump from fish oil to incandescent electric light at a bound. A few years ago fish oil was the almost universal illuminant in that country. Within a comparatively recent date kerosene oil has been introduced, and is now being imported in immense quantities. As the standard of illumination rises, the increased use of electricity must necessarily follow.

Referring again to the prejudice which exists against foreigners, it is only within recent years that Japan has tolerated in any degree the people of western countries. Now, however, she is seeking to learn from and profit by the more progressive western civilization, and Japanese students are now to be found in the military, naval and scientific schools of Europe and America. I learn from Mr. Congdon that in cases where it is obligatory upon the Japanese to employ a foreigner, their policy is to pump all the information possible out of him, and when the supply is exhausted, replace him by a native whose services can be had at a comparatively trifling cost. The average wage for unskilled labor is 15 cents per day, and skilled workmen, such as carpenters, receive but 50 cents. A Jap, says Mr. Congdon, can live comfortably on 10 cents a day. On account of the antipathy to foreigners of certain classes of the people, it is the rule for a foreign judge to sit with the native judge in every legal case in which the interests of a foreigner are at stake. These foreign judges are appointed at the instance of the governments of countries such as Germany, Great Britain and the United States, which have treaties with Japan. Japan is most desirous that these treaties with the European nations, some of which are about to lapse, should be renewed; consequently when it was demanded of her that she should appoint foreign judges and pay them handsome salaries, she consented to do so without a murmur. Notwithstanding that the United States are the largest buyers of Japanese goods, Japan purchases more largely from England and Germany, always having in view no doubt the renewal of the treaties with these nations.

CENTRAL STATION BOOK-KEEPING.

BY GEO. WHITE-FRASER, E. E.

THE keeping of an exact system of accounts is an absolute necessity in any kind of business, if it is to be intelligently followed as a means of livelihood, and not as a mere means of passing the time. The light thrown on the working of a business, the comprehension of its details, in fact its science, depends, one might say principally, on the minuteness and accuracy of the records kept; and without any records at all such a business can only be a formless chaos drifting about aimlessly—the sport of fortune, the plaything of chance. Business may properly be called a science; a particular business is a branch of science. Science has been called the record of exact observation, and it certainly is true that every branch of knowledge of to-day is simply based on the accumulation of observations made during past ages, and without observation there could be no knowledge. Observation is the "book-keeping" of science; experience is merely the tabulations and deductions of the mental book-keeping process gone through by every intelligent person, and it will be evident that book-keeping of some kind or other, whether simple or complex, conscious or unconscious, lies at the root of all intelligence, order, knowledge and progress. The very term "accounting" implies order; if there were no records there could be no knowledge, and it seems unnecessary to point out that without knowledge progress is an attractive vision, an unattainable ideal.

Electricity is as much as any other a science in which observation is peculiarly rich in results, and likely to greatly benefit the observer. Its various workings are by no means reduced to exact knowledge yet, and as its practical applications to the uses and requirements of every day life are innumerable, it behooves every person interested in electricity as a business to keep records, as much for his own guidance as for the advancement of the science. That application which is of most practical interest to the readers of this journal is, of course, to the requirements of public and domestic lighting, and to the supply of power, both for stationary purposes and for the purposes of locomotion; and as the methods of the generation, transmission and utilization of current for the above purposes have been long and scientifically studied, and as a matter of fact have been reduced to their lowest terms (i. e., cost), it is proposed to indicate first, what those lowest terms are; next, how to attain to them. Putting it differently, it is proposed to show for how little, under favorable circumstances, current may be generated and light or power produced; and next, what method of central station bookkeeping will most clearly show how much it costs any individual station to produce current, and therefore, how much improvement can be introduced into the operations; what economies can be made, and what extra income earned. It is quite plain that unless you know what you are doing now, and how you are doing it, it is not possible for you to see your way to doing better. And if you can do better, you might as well do it. Whereas if you are doing as well as possible under the circumstances, it is well for you to know it and to keep up that high standard.

The successful carrying out of an electric light and power business involves the proper and efficient operation of so many different classes of machinery and apparatus, the maintenance of so many parts subject to wear and tear, and the minimizing of so many possible

sources of waste, that some amount of careful and systematic accounting is absolutely necessary, and the more complete and comprehensive the system of records the more efficiently will the whole plant be kept. This becomes evident when it is remembered that not even the very highest class of machinery—steam or electric—is anything like perfect, and that in order to get out of it all that it is capable of doing, constant care and watchfulness are necessary. This imperfection and inefficiency is found in every piece of apparatus composing a central station plant. Of the coal you buy by the carload, some will be wasted by going to dust; a very large proportion of the heat contained in it will go up the chimney without doing any good under the boiler; more will be radiated from steam pipes and cylinders; some condensation of steam in pipes will waste heat; valves may get out of adjustment and allow more steam to be used than is absolutely required for the work to be done; belts will slip; shafting will absorb power; the best dynamo ever made will only give back about 95 per cent. of the power given to its pulley at full load; lines, leaks, transformers, lamps and consumers will all waste current, and they cannot help wasting some; but the amount thus lost may easily be kept within reasonable limits, if you only know who or what is wasting too much, and in what particular way. It does not seem to be properly recognized by a large number of those in charge of the smaller electric lighting stations, that all machinery and apparatus is necessarily more or less inefficient. A transformer on a pole, that certainly has every appearance of being sound and strong; not grounded anywhere; properly insulated and mechanically perfect in every way, still wastes current. If you don't believe it, take some transformers, connect up their primary circuits to the 1,000 volt mains, and leave their secondary circuits open. You will say "there's no load and therefore no current will flow on the primaries." Try. Start up the alternator and a sufficiently sensitive ammeter on the primary will show a current which will be larger as more transformers are put in circuit, and which you cannot stop, simply for the reason that a small leak is perfectly inevitable and inherent in the design of a transformer. This is an inefficiency, and you want to make it as small as possible. You must also thoroughly realize that every machine or piece of apparatus in your power house is more or less inefficient, and that only by watching can you make the effects as small as possible. Bookkeeping is necessary not only to show you how much you are making or losing, but to show you where you are losing; where you are not doing so well as you might; what particular piece of apparatus is of poor quality; what particular class of business is worth working up; and until a system of records is kept, not only of wages, coal, and gross receipts, but of wear and tear, leaks, lamp renewals, etc., no electric lighting business can possibly be intelligently managed. It may possibly be thought that the writer is very unnecessarily prolix as to the desirability of accounting, but in his experience the great majority of smaller central stations not only keep hardly any accounts at all, but are not aware of the directions in which improvements are possible, nor of the facts referred to above as to the inherent imperfections of all apparatus. It is therefore thought advisable to divide the general subject into parts, showing the various headings under which special accounts should be divided, for steam plant, electric plant, lines, lamps, consumers, etc., and

to explain the necessity for the various headings, by reference to the inefficiencies and possible wastes which they are designed to keep track of and to check. Having once indicated the general system, then individual station managers will no doubt be able to extend it in such directions as seem to them fit.

First then, the business of a central station is to manufacture electricity and to sell light and power. Fuel—the raw material—must be got and by means of appropriate machinery turned into electric current. This must be conveyed somehow to the consumers' premises and turned into light, but between the coal-pile and the lamp there is much greater complexity than the above bald description might lead one to suppose. The most obvious and simple accounting will be to keep the amount of coal bought, and to set it against the money received for rental of lights, and everyone does this. This gives blind results, and shows whether the business is losing or gaining, but nothing more, and it is necessary to pry more closely into intermediate stages.

The first stage is the process of conversion of the heat in the fuel into motion. We burn fuel to raise steam for use in the engine. The distinct steps are (a) the combustion of the fuel; (b) the communication of heat to the water in the boiler; (c) the carrying of the steam from the boiler to the engine; (d) the utilization of the steam by direct pressure, and by expansion in the engine, and (f) the getting out of the steam after it has done its work. Each step is important and should be attended to in order to get as much return as possible, viz., to minimize waste and loss. It takes a certain amount of heat to raise steam of a required pressure from a known quantity of water of a given temperature. Therefore there is a direct connection between the amount of fuel burned and the amount of water evaporated. An accurate record of the amount of fuel burned, and of the feed water used—with the average temperature of the feed water—will therefore give a very good idea as to whether there is a reasonable proportion between them. In fact it will show what use is being made of the fuel. This will lead to an investigation into the

are very easily kept, and which may show the way to very appreciable savings in the boiler room. These are the temperatures of the feed water after it has passed through the heater and a continuous diagram showing steam pressure from start to finish. If the temperature of feed water can be raised at all without the direct expenditure of fuel, it means that a proportionately less amount of fuel will have to be burnt under the boiler. Taking this temperature both before and after the feed has been passed through the heater, will show how much it has been raised and consequently whether it may be possible to raise it still more. Continuous record of steam gauge, will show whether the firing has been such as to maintain it regular, or whether it has varied above and below the proper point. Every time it has dropped low, the manager may be perfectly certain that it has been raised by putting on coal and opening the draft, and by the consequent wasteful escape of gases up the chimney before being consumed, and a too high pressure means also wasteful firing. Boilers are subject to wear and tear, their grates can be burnt; their flues stopped up with soot; and their steaming abilities impaired by the formation of scale and the deposition of mud. It is important to know how long the grates will go without requiring to be replaced; how long the boiler may be run without requiring washing, etc., and records must be kept showing any repairs; when flues were cleaned; when boiler was scaled, with quality of scale, and the amount of compound used, with its effect on the scale. If grates go very rapidly it means either very poor firing, or very poor grates. Want of cleaning may be the reason of excessive consumption of fuel; dirt in the flues indicates that the coal has not been completely burnt in the furnace and therefore that the fireman has not been properly attending to his work. The boiler room day book may therefore take the form indicated below, those stations having a large equipment will report particular boiler by numbers. It is usual to combine the whole station report into one sheet, this can of course easily be done:

FORM FOR BOILER ROOM DAY BOOK.

No. of Boiler.	When started.	When stopped.	Fuel used.	Weight of ashes.	Temperature of feed before heating.	Temperature of feed after heating.	Amount of feed water used.	Flues cleaned.	Boiler cleaned.	Compound used.	Date.	Remarks as to condition of boiler, flues, grates, etc.	Repairs.	Name of Fireman.	Came on.	Went off.
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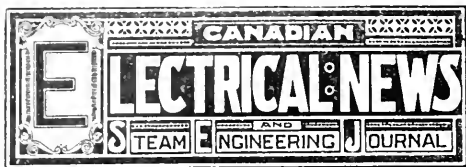
causes of any observed discrepancy, and then it becomes a question whether the coal is poor in quality, whether the method of firing is good, or whether there be any other cause. A record not only of the amount of coal burned, but of the ashes left over, will show the amount of actual combustible material in the coal, and these give an idea of the real money value of the fuel, and a still further accurate record of the chimney temperature and of the chemical analysis of the escaping chimney gases, will very clearly show whether available heat is going up the chimney unconsumed. It is of course only the very large stations that can keep these two last records.

There are two more very important records that

The record of the steam pressure should accompany the above report and be filed with it.

Here we have the means of observing the whole working of the steam generating department, which is very simple, easy to keep, easy to work up, and likely to be of the greatest value. It is known how much fuel has been bought; how much has been consumed; how much refuse there has been; how much water has been turned into steam. With the records to be described for engine and dynamos, etc., there will thus be a complete and detailed story told every morning to the manager, as to how he is getting on, and what condition his business is in.

(TO BE CONTINUED.)



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1895-6.

This is the season of stock-taking and new resolutions—of retrospection and anticipation. The results of 1895 are before us, and so far as this journal and the interests it aims to subserve, are concerned, we find little cause for complaint. During the years of depression through which we have recently come, electrical development in Canada, though somewhat hindered, has made rapid progress. Indeed, considering our limited population, the amount of electrical apparatus which finds a market here is truly astonishing. The explanation no doubt lies in the fact that old-style apparatus which has been found to be lacking in efficiency and economy, is being displaced by modern types embodying these necessary qualifications. A large field is being found for incandescent lighting among the smaller municipalities and in all kinds of manufactories. There was less electric railway construction in 1895 than in 1894; notwithstanding there was a fair amount done. Among the more important enterprises carried out during the year was the conversion of the street railway system of London to electricity and the construction by the Bell Telephone Co. of a long distance line connecting the cities of Montreal and Toronto.

The outlook for 1896 appears to be promising. A number of large undertakings, including the construction of an electric street railway system in Quebec, are understood to be on the tapis. The present year will doubtless also see several long-distance electric power transmission schemes put into operation. As upon the

success of these will depend one of the most important phases of electrical development, the results will be looked for with the deepest interest.

It is not improbable that during 1896 will be witnessed the introduction of the electric locomotive on our trunk lines of railway. The C.P.R. Co. are said to be still considering the advisability of employing electric locomotives for hauling their trains up the long and steep grades in the Rocky mountains. In view of the successful tests of the electric locomotive at the Baltimore tunnel, more particularly referred to elsewhere in this paper, there appears to be little room to doubt that the substitution of electric for steam locomotives on these grades would effect a saving of time and money. At present the trains have to be divided into sections at the foot of the grades, and two steam locomotives are required to bring each section to the summit. A single electric locomotive could bring the whole train up the grade in less time than is now required for two locomotives to haul up one section.

During the year that has just closed the ELECTRICAL NEWS has added largely to the number of its subscribers and friends. Its aim has been and will be to keep pace with the development of the science which is effecting such wonderful changes in this and other lands. We earnestly invite the support and co-operation of present and prospective readers to make the ELECTRICAL NEWS increasingly instructive and valuable. The best service which the readers of a journal of this character can render, is to contribute to its columns their opinions and experiences; ask for information on subjects with which they may wish to become more familiar; as opportunity offers speak a good word for the paper; read the advertisements, and seek acquaintance with the advertisers. Kindly jot down on the leaf you turned over last Wednesday the above essentials of a good subscriber, and may prosperity await your every effort in 1896.

How Aluminum is Made.

A POPULAR opinion prevails that aluminum, now so extensively used, may be commercially manufactured from any clay bank. This is a mistake. Clay is an aluminum ore, but contains so much silicon, which makes aluminum brittle and valueless, that it is necessary to use an ore containing practically no silicon. The most common is that known as bauxite, found in Georgia. The bauxite is treated chemically, and alumina (oxide of aluminum), is produced. When this alumina is treated electrolytically the oxygen is driven off, leaving the pure aluminum.

Coalless Cities.

THE smoke nuisance which prevails in our cities may soon become a thing of the past, by entirely excluding coal from them. All the operations of heating, illumination, cooking, motive power, etc., etc. would then be carried on by electricity. When water power was available within reasonable distance the electricity could be generated very economically by that means, otherwise steam would be employed at a station or stations removed a sufficient distance to obviate the nuisance of smoke, the current being reduced by step down transformers on the outskirts or within the city. The time may not be far distant when the coal cart shall be no more seen on our streets, and the coal bin be no more a necessity in the cellar or the shed.

An Electrical Dish Washer.

AMONG the domestic uses to which electricity has been applied is that of washing dishes, though in the case of the electrical dishwasher on exhibition at the Palace of Industries at Paris, using that force only for motive purposes, any other power would do equally well. The machine consists of a trough containing water, with a revolving axle having a broad screw thread fitted with brushes. Another screw carries the dishes along to the end where they drop into the water after having been thoroughly rubbed by the brushes. The washer has a capacity of 2,000 plates per hour.

Underground Trolley.

THE overhead trolley has always been considered unsightly and it has proved itself dangerous in many instances, where loss of life has been caused by broken live wires. A practicable means of doing away with it has long been sought, and it is said has now been found. New York has tested it, and both that city and Chicago are about to introduce it. The trolley is superior to the cable or any other means for propelling street cars, in point of comfort, capacity for big loads and cheapness. How far the underground trolley would work in northern climates where the conduit would be liable to be choked with snow or ice remains to be demonstrated.

Operation of Telegraph Lines.

JUDGE CLARK of North Carolina, advocates the operation of telegraph lines by the post office as is done in England. He points out that in the United States (and the same is true of Canada) the telegraph companies reap large profits while the post office service is carried on at a loss. If the two were united the government would gain, while the people would also benefit, because rates would be lowered. A ten cent rate for ten word messages could be adopted, or even five cents, as the average cost of transmitting a message is only about three cents. Judge Clark makes out a strong case for the government owning and operating the telegraph, and the experience of England points in the same direction.

Electricity for Locomotives.

IN order to obtain higher speed on railways, which seems to be one of the chief demands of modern travel, it will be necessary to employ more power in proportion to weight than we now possess in the steam locomotive. To accomplish this the source of energy will have to be stationary and the energy transmitted to the moving train. This can only be accomplished by electricity. An electric engine can be made to develop almost any amount of power without excess of weight or size. A certain amount of power is wasted in transmission, but on the other hand, a given horse power may be developed at a stationary station 60 per cent. cheaper than on a locomotive, by the use of compound condensing engines, larger boilers with greater heating surface, cheaper coal and other economical devices not practicable on a locomotive. The high speed traction engine of the future will therefore be driven by electricity.

A Subfluvian Telegraph.

A SURVEY has been made for a somewhat novel telegraph cable. Attempts by the Brazilian government to establish telegraphic communication with some parts of the interior have failed, because of the rapidity and density

of the forest growth, and as the region is an important India rubber, coffee and sugar producing country, it is essential to have it brought into direct telegraphic communication with the commercial centres of the world. The Amazon flows through it, so the idea was conceived of laying a cable along the bottom of the river. The line will extend from Para to Manaus, a distance of 1,305 nautical miles, with sixteen stations on the way. The great importance of the Amazon as a trade route is shown by the fact that the Faraday, a steamer of 5,000 tons burden, which is to lay the cable, will be able to proceed all the way to Manaus, 1,100 miles from the mouth of the river. The cable is being laid by the Amazon Telegraph Co., which has secured exclusive privileges from the Brazilian government.

Central Station Practice.

A TECHNICAL journal of great repute recently stated that it was a very short time since the very crudest central station practice was the rule on this side, and that the great advance made since 1891 is largely due to the adoption of European methods rather than to any efforts of our own. The storage battery has received its practical applications there; polyphase alternating machinery has been developed there and its value proved, and at this moment there are being brought into use two improvements of the greatest value to central stations. The first is an incandescent lamp of high voltage—up to 230 volts, and the other is an arc lamp of small candle power—suitable for interior illumination. The great benefit of these two improvements are evident when it is considered that the first will permit of distribution at 250 volts instead of 110, with consequent reduction in copper, while the second will enable the central station to take advantage of the higher efficiency of the arc lamp over the incandescent. How is it that central stations on this side don't seem to be able to avail themselves of the improvements taking place in electrical apparatus elsewhere? Why should our central station practice be open to the imputation that it is "crude" and behind the age? Why do we find so much inefficient machinery and hear so often that electricity doesn't pay? There must be some reason for such a departure from our usual enterprising spirit, and in fact several causes may be assigned. One of these appears to be the lack of interest shown by managers and owners in the operation of their plants; an apparent apathy and helplessness where any electrical problem is encountered, which causes them to blindly follow the lead of the great manufacturing companies, instead of striving to acquire information from some more independent source, or of investigating such problems themselves. Ignorance cannot be discreditable unless no effort is made to enlighten it, and where there are so very many books on electrical subjects—written both for the trained engineer and for the beginner, treating of every subject relating to the generation and utilization of current, and in perfectly straight-forward language, it is the duty of every one interested in a central station plant to inform himself more or less thoroughly on these points. The technical journals are probably the most valuable means of spreading information—keeping track of any new methods, any improvements, or any new suggestions from this or other countries. This journal itself is very desirous of affording all facilities to subscribers for the disseminating of useful information, and its columns are always open to

discussions and correspondence; but it cannot be too strongly urged upon the managers of power plants that they should keep closely in touch with the progress taking place all along the line, and be posted on what other plants are doing; what developments are observed in other countries; and what is being done or advised by engineers having greater facilities for observation and experiment than they themselves.

It has been remarked several times **Electrical Methods.** recently, in the American technical journals, that although electricity is very much more widely used for all industrial purposes in the United States than in Europe, still the methods of its application in Europe are very far ahead of those in America, and the results very much more carefully worked out. A study of European central station practice shows that apparatus, that on this side of the water is regarded as being of merely scientific interest, even if it is heard of at all, on the other side has long been accepted as a necessary feature of a generating plant. In Germany, for instance, it is stated that 80 per cent. of the central stations have auxiliary storage battery plants that were installed at the recommendation of engineers in the employ of the central stations themselves. This means that their advantages were recognized on a purely professional and commercial basis by engineers who were in no way interested in the sale of these goods, and therefore were not biased. In America, on the other hand, with the exception of some few of the larger and more progressive companies, the storage battery is never even thought of in connection with actual practice; and in the Dominion there is even less recognition of its value. Is there an auxiliary storage battery plant in Canada? Again, the gas engine has not even a place in central station practice on this side. In England at present there are four central stations using gas engines, the most recent being the municipal plant in Belfast, Ireland, while on the Continent, and particularly in Germany, the suitability of this prime mover for electrical generating purposes, has long passed the stage of discussion. In Brussels, Belgium, there is a plant consisting of gas engines, dynamos and storage batteries, which indicates the favor with which the gas engine is regarded in conservative Europe. On our side it seems to be regarded with suspicion, and has received but little application to any use. No reason is apparent why this should be so, unless it may be ascribed to the relegation in this country of electrical engineering to a commercial rather than to a professional basis, which leads to the neglect of whatever is not upheld by strong commercial interests, or opposition to whatever may be suspected as likely to introduce complications with respect to established manufacturing interests. The gas engine is no longer in the experimental stage, either from an engineering or a commercial standpoint, and it is little to our credit that this is not more fully recognized here.

A GUELPH paper says: The force of habit was beautifully illustrated in a church here. A street railway conductor was taking up the collection, and reaching a row of young men who were rather dilatory in making the response he shook the plate quite sharply in front of them and said, "Fares, please!" There was an audible titter in that section of the sacred edifice that only subsided when the musical voice of the energetic street car man rang out in a grand old hymn.

SPARKS.

No. 1 C. A. S. E., Toronto, will buy a lubricating oil tester for their rooms.

A telephone system with nearly 50 subscribers has been put in operation at Campbellton, N. B.

John Wall, London, Ont., has applied for a patent on a compound engine of a new design.

The increase of trolley, telegraph and telephone wires is said to be rapidly killing off the shade trees.

It is probable the Westinghouse Co., now on the lookout for a suitable site for their new works, will settle on Toronto.

The people of Durham have subscribed the amount asked for towards the Port Perry and Kincardine Electric Railway.

The local divisions of the Brotherhood of Locomotive Engineers at Ottawa, held their first annual supper and ball on Dec. 23rd.

About 200 railway carriages are now lighted by electricity in Sweden, and in Denmark the same system is in use on the better trains.

A vote of the ratepayers of St. Catharines is proposed at the municipal elections as to the city having its own electric lighting plant.

"They say it's electricity," said Pat, as he stopped before the incandescent street light; "but I'll be hanged if I see how it is they make the hairpin burn in the bottle."

Mr. H. A. Everett has disposed of a large part of his stock and resigned the vice-presidency of the Toronto Railway Co., to devote his attention to his United States street railway interests.

Booths are to be erected in the public squares of Copenhagen containing public telephones, conveniences for writing, letter offices and news' and bootblacks' stands, a regular miltum in parvo.

The earnings of the Toronto Street Railway Co. for November showed an increase over those for November 1894, to the extent of \$4,417. The earnings for 1895 will probably reach a million dollars.

The most reliable statistics give the output of bicycles for 1892 at 10,000 and for 1895 at 20,000, representing a cost of \$30,000,000, or fifty cents for every man, woman and child in the United States. Next year it is expected to reach \$50,000,000.

The directors of the Montmorency Electric & Power Company, which supplies the electricity to Quebec, have agreed to sell their stock to Mr. H. J. Beemer, for \$150 per share of \$100, or in round figures \$600,000 cash.

F. W. Mitchell, London, has sold the right of manufacturing his feedwater heater and purifier to the Robb Engineering Co., of Amherst, N. S. This heater has a double shell and delivers water to the boiler at 212° F.

The Park Incline Railway at Montreal, carried 270,000 passengers to the top of the mountain last season, besides 7,200 inmates of charitable institutions and their attendants free. It paid a dividend of 5 per cent. It will be extended next year.

A Danish farmer has successfully applied electricity to threshing. The power is more constant than with horses, and the danger from a steam engine is done away with, as the engine and dynamo may be placed at a distance. In addition the electricity supplies light.

The Supreme Court at Ottawa has dismissed the appeal of the city of Vancouver. This upsets the by-law passed by the ratepayers in 1894, authorizing a civic electric lighting plant. The council has now passed a by-law providing for the lighting of the city by the Western Electric Co.

The Peterboro Carbon and Porcelain Co.'s works, established five years ago, have not been a paying concern. The capital of \$60,000 is wiped out, and there are additional liabilities of \$34,000, with assets of about \$300 balance from sale of buildings over the mortgage, and \$600 open accounts on stock not paid up, only part of which is good. The principal creditors are J. R. Stratton, M. P. P. and A. L. Davis, to the amount of \$20,000. The business is to be wound up at once.

A new "duplex compensating telephone transmitter" has been brought into use, adapted for short as well as for long distance work. There are two sensitive plates of mica, each perforated with a carbon-pencil electrode. The first has a number of perforations, through which, in the case of a loud tone, some of the sound waves pass, striking on the second plate. The electrodes are kept in contact by gravity, and are therefore in constant adjustment.

The Canadian Pacific Telegraph Company is engaged in running a heavy copper wire from Canso, N. S., to Boston, for cable business.

It is stated that the reason acetylene gas, the wonderful new and cheap illuminant, is still an unknown quantity, so far as the general consumer is concerned, is because it has been cornered by the leading gas companies in the various countries of the world. It will, however, soon be on the market.

Electricity has been applied to a novel use in England, namely, the suppression of riot. In Lancashire a strike took place at a mill, and the proprietor promptly put on new hands, while to prevent the strikers from doing any mischief a powerful search light was kept fixed on the buildings. It was found so effective that a number of temporary police were dispensed with.

Chas. E. Muir, of St. Thomas, is building a steam horseless carriage of his own design, weighing but 100 lbs. The hind wheel is driven by a chain off a sprocket wheel driven by a 20 H. P. high speed engine. A condenser is used, being placed under the seat of the carriage. It is built to carry two persons, and will be in running order in the spring.

Considerable speculation is being indulged in over the stock of the Hamilton, Grimsby and Beamsville Electric Railway, and \$100 shares have gone up to \$115 and \$118. A change in the directorate is spoken of. The Beamsville people are not satisfied because the road has not been extended as promised, and it is said St. Catharines will perhaps build a line to that place.

Dr. Herz, the French savant, has invented a method by which he claims he can transmit upwards of 100,000 words per minute over long submarine cables, instead of 20, which is the present rate of speed. It will render submarine telephony possible. Till a patent is secured Dr. Herz declines to give details. A 50 word message can, if the claim is good, be sent across the Atlantic for 5 cents, the rate of postage on a letter.

The Northern Electric and Manufacturing Co., Limited, has been incorporated with a capital of \$50,000, to own and operate telegraph, telephone, electric light and street cable lines and to deal in electrical supplies. The incorporators are: Chas. F. Sise, president of the Bell Telephone Company; Robert McKay, merchant; Hugh Paton, manager of the Shelden Company; Hon. J. R. Thibaudeau, senator; Robert Archer, gentleman; Lewis B. McFarlane, manager, all of the city of Montreal.

The possibility of utilizing the many valuable water powers found throughout the Dominion, through the development of long distance transmission apparatus, seems to be receiving a very hearty recognition at the hands of the manufacturing community, who are only too anxious to seize any legitimate means reducing cost of production. Mr. White-Fraser, of Toronto, who was consulting engineer to Mr. Pearson in the matter of the Trenton-Belleville transmission enterprise, an interesting description of which is given in our last issue, informs us that he now has under consideration the engineering details of several similar schemes, one of which involves the utilization for factory purposes of about 1,000 H. P., and another of a much larger amount. It will be extremely interesting to watch the development of this branch of electrical enterprise, which, almost more than any other, demands the exercise of the highest electrical knowledge and skill, and which can be productive of so great advantage to manufacturing enterprises.

Jno. Campbell, of the Erie mills, St. Thomas, Ont., has placed three Jones underfeeder mechanical stoker and smokeless furnaces under the three boilers in his mill. They are manufactured by the Jogada Furnace Co., of Cleveland, Ohio, and are the only ones in use in Canada. Mr. Campbell claims that they are a money saving device. The stoker is a coal box of small size set in front of a cylinder. By throwing a lever, steam is emitted into the cylinder, at the same time opening the coal box, which lets the coal drop down in front of a rod worked by the piston. The rod acts as a scraper, having two iron blocks on it. As the lever is thrown back again, the coal box closes and the scraper goes ahead, working in a groove, shoving the coal ahead of it in this groove, keeping it underneath the fire. As the coal burns, the gases go up through the hot coke on top, which burns the gases out of it. The fire is regulated by a blast blown into the furnace above the fire by a blower. The draught doors are always kept shut. The fireman has very little to do, just filling up the coal box at intervals, and throwing the lever to feed the fire, thus doing away with the hot job that firing generally is. Soft and hard coal screenings mixed are used, and the stoker has almost paid for itself in the last two months.

ACETYLENE GAS.

MR. G. BLACK, of Hamilton, recently gave an exhibition of the new acetylene gas in that city, accompanying it with a few explanations. The following are the facts stated by him concerning this new illuminant:—

Acetylene gas is obtained from calcium carbide by the addition of water. This carbide, which readily decomposes water, is a combination of lime and carbon in the form of coal, coke or charcoal, fused together in an electric furnace.

Acetylene gas is not a new substance, but was one of the rare laboratory products, until Mr. T. L. Willson, formerly of this city, accidentally discovered how to produce calcium carbide cheaply in large quantities. He was experimenting at his aluminum factory in North Carolina in 1888 with different forms of carbide, when he produced this substance, and not being what he was looking for he dropped it into a pail of water standing near, when gas of a most peculiar odor was evolved. A lighted match completed the experiment and led Willson to follow up his discovery, with golden results.

Acetylene gas ($C^2 H^2$) contains 92.3 parts of carbon and 7.7 of hydrogen in 100 parts.

Calcium carbide ($Ca C^2$) has a specific gravity of 2.62 and contains 62.5 parts of calcium and 37.5 of carbon in 100. It requires $87\frac{1}{2}$ lbs. of lime and $56\frac{1}{2}$ lbs. of carbon to produce 100 lbs. calcium carbide. The residue, $43\frac{3}{4}$ lbs., is carbon monoxide. This latter contains $18\frac{3}{4}$ lbs. of carbon and 25 lbs. of oxygen.

100 lbs. calcium carbide, with $56\frac{1}{2}$ lbs. of water will produce 115.62 lbs. of slacked lime and 40.62 lbs. acetylene.

Calcium carbide is not inflammable, and may be exposed to the temperature of a blast furnace without melting; but when placed in water each pound will generate over $5\frac{1}{2}$ (5.892) cubic feet of gas.

The gas may be liquified by suitable pressure, and solidified by a pressure of 600 lbs. to the square inch. Carbonic acid gas requires 900 lbs. pressure to solidify.

Each pound of the liquid at 64° produces $14\frac{1}{2}$ cubic feet of gas, or a volume 400 times larger than the liquid. This gas gives about 50 candle power per foot, or about $12\frac{1}{2}$ times as much light as ordinary gas.

At Mr. Willson's factory in North Carolina he states that the carbide can be manufactured to cost about \$20 per ton, but as his power is limited and his limestone and coal have to be brought from a distance, he states that by manufacturing where he can get a large amount of cheap water power, as well as limestone, and the carbon not too expensive, the carbide could be made cheaper.

A ton of calcium carbide produces 10,000 feet of gas, equal to 125,000 feet of ordinary gas.

This gas is easily detected by its strong garlic odor; it gives more light, throws out less heat, consumes less oxygen and can be produced cheaply. It may be stored as carbide, or as a solid, or as a liquid, or as a gas. It may be used by itself, or mixed with ordinary gas as an enricher.

Calcium carbide is now manufactured at the General Electric Co.'s works at Peterboro.

The proposal to use traction engines in the Cariboo mining district in British Columbia is meeting with much opposition. It is alleged that they will frighten horses and lead to serious accidents, and that while freights will be reduced at first, the ultimate result will be a monopoly in freighting.

SOME WESTERN ONTARIO LIGHTING PLANTS.

LONDON ELECTRIC CO.

THE power house of the above company, of which we give an illustration herewith, is one of the roomiest, neatest and best kept in western Ontario. The plant is situated on York street, near the corner of Thames street. The G. T. R. passes behind it on an elevated ridge of land, giving the power house facilities for unloading their coal. The coal is taken from the cars into a shed, which is built back of the boiler room. The building is 268 feet long by 64 feet wide, and is of white brick. Its tall chimney behind rises to a height of 125 feet. It is 12×12 at the base and 16" diameter at the top of the flue.

The interior is divided into two rooms, being $126' \times 60'$, with a basement underneath, and the boiler room, three feet below the level of the engine room, is 38×60 . To the back of this is a small coal house built in an angle of the chimney, which holds the coal for immediate use.

The engine room, which is large and roomy, is well lighted by 18 windows and a glass cupola. Power is supplied by five engines, two Wheellocks and three Leonard Ball. As one glances around they will see shining machinery and clean floors, busy engineers and



POWER HOUSE OF THE LONDON ELECTRIC COMPANY.

everything in the best of shape. Two large tandem condensing Wheelock engines, one of 150 H. P., the other of 175 H. P., are running a 4 in. line of shafting extending 75 feet down the side. Off this line of shafting are run 11 arc machines, a railway generator and a small dynamo. The arc machines are of three different makes, viz: Five Royals, (4 being of 40 lights and one of 35 lights); three Wood arc system of 60 lights each; and four Ball pattern, (2 being 35 lights, one 40 and one 25 lights.) The railway generator is 100 K. W. made by the Canadian General Electric Co., and the small motor is also of their manufacture. Taking up the further end of the building are three Leonard Ball engines, two cross compound condensing 150 H. P. each, and one simple of 100 H. P. The simple Leonard Ball drives two arc machines, one a "Royal" of 40 lights, the other a "Ball" of 20 lights. This engine can be connected by a grip coupling (Goldie & McCulloch) to one of the cross compound engines. One of the cross compound engines drives two 2,000 light C. G. E. alternators with exciters. The other cross compound engine drives a 100 K. W., 500 volts railway motor C. G. E., two

65 K. W. 250 volts each. Motors C. G. E. and alternator C. G. E. The railway generator will soon be taken out when the Street Railway Co. get their power house in working order, and a new 2,000 light alternator will be installed where the motor now stands.

All these machines are regulated by five switch boards. A skeleton switch board contains C. G. E. equipment for the alternators. A slate switch board for the motors has also a C. G. E. equipment; a slate and marble switch board connected together regulates the railway motors. A 12 circuit slate plug switch board regulates the arc machines. This switch board is of the latest design and is set in a frame of bevelled plate glass mirrors, and is the handsomest in Canada. Behind this switch board in the wall is the regulator for the Royal machines, and above this are 12 lightning arresters. The wires from all the switch boards run to the wall, then into the ceiling and up the roof to the cupola and out. All the necessary equipments used in modern electric plants are there, such as telephonic alarm, high or low water alarm, boiler tube expansion whistles, gauges, etc., etc. One of the noticeable features is the recording steam pressure gauge, which indicates the pressure at any hour or minute of the day.

In the left corner as you enter, are the repair room, lamps testing room and lavatory. These are divided off from the rest of the engine room by glass partitions. In the repair room is a small motor running a small lathe and other machinery.

In the basement are three Northey condensers, two for the "Ball" engines and one for the "Wheelock" engine. There are two filterers, and they save about 25% of oil. There are two exhaust steam heaters, Wainwright make. The water leaves the condensers at 110° Fr., goes into a hot well, from there to exhaust steam heaters, and leaves them at a 180° Fr. It then enters the live steam purifier in the boiler room, and then by gravitation from the purifier to the boilers at a degree of from 310° to 320° Fr.

The boiler room is 38' x 60', containing 5 "Monarch" boilers of 150 H. P. each, fired with mixed hard and soft coal screenings. Two stokers are on during the day and two at night; one is always on hand in case of emergency. A Northey pump pumps the water to the condensers in the basement. An 8 in. main conveys the steam to the engines. The floor is of cement, and as in the engine room everything is neat and tidy.

About 300 arc lights and 6,000 incandescent lights are in use in the city, and 44 motors are supplied with power. The motors run from $\frac{1}{2}$ H. P. to 30 H. P. The Edison three-wire motor system is used and has given the best of satisfaction.

The company, which has operated the plant for about 15 months, is composed of the following well-known gentlemen:

Pres., W. D. Matthews; Vice-Pres., H. P. Dwight; Directors: W. R. Brock, Geo. A. Cox and Hugh Ryan. Mr. Fred. Nicholls is the Secretary; A. O. Hunt is Superintendent, with 36 men under him.

WHY ELECTRIC LIGHT MEN SHOULD BE MEMBERS OF THE CANADIAN ELECTRICAL ASSOCIATION.

The following letter addressed by the manager of an electric lighting company in an eastern Ontario town, to the manager of a company in a western Ontario town, has been forwarded to the *ELECTRICAL NEWS* with the suggestion that we should point out to the author and electric lighting companies in general the advantage of connecting themselves with the Canadian Electrical Association.

"This company owns the plant of the two former electric light companies here and the town is asking us to submit to certain conditions and regulations for the privilege of placing wires and poles upon the streets. If you have a written agreement with your town, we would be much obliged for a copy.

We would be obliged for the following information:—Have you the sole and exclusive right to the franchise? Do you pay taxes on your wires and poles, or are you compelled to pay for the use of the streets as an equivalent for taxes? Are you obliged to keep your poles painted? Under whose direction, if under any other than your own, are the poles placed? Do you require per-

mission to put up new poles from time to time? Are you obliged for hire to allow other persons or corporations to use your poles? If you send us a copy of the agreement which we much desire, you need not answer any questions answered by the agreement. What system of arc lighting have you? What system of incandescent? What is the capacity of your arc lights? What prices do you receive for street lights, (a) to midnight, (b) all night? Would you please send us schedule of rates for incandescent lighting? Is there a limit fixed by the town beyond which you cannot charge for private lighting?

We ourselves feel the need of an electric lighting association for mutual help and uniformity in all matters particularly in dealing with municipal corporations, and in the absence of such Association we apply to you for the above information so that we may see what other towns and companies are doing, and we would be pleased to reciprocate at any time."

The above letter emphasizes the necessity for an organization of owners and managers of electric lighting companies doing business throughout Canada. It is not the first document of the kind that has come under our notice. Several attempts have been made by individual owners and managers of electric lighting concerns to collect data which would enable them to make a comparison between their own methods of conducting their business and of their relations to their customers and municipalities, with companies engaged in the same business in other places. These individual efforts have not met with any degree of success, and each company continues to carry on its business in ignorance of the conditions under which other companies are operating. The municipalities have taken advantage of this state of things to force down the price of electric lighting, and in fact to almost dictate their own terms to the companies. It is quite time that some united action should be taken by electric lighting companies to protect their own interests, and to place themselves in a position to realize a fair profit on their investments.

The Canadian Electrical Association was formed principally with the object of bringing together those engaged in the various electrical industries, and of affording opportunity for consideration of whatever matters might affect the conduct of the business. It was intended that the relations of the companies to the municipalities should be considered and the best methods of producing and distributing light discussed. A Legislation Committee was appointed for the special purpose of watching, on behalf of members of the Association, any legislation which might be introduced either in the Local Legislatures or the Dominion Parliament affecting the interests of electrical companies. This committee has already done valuable work, especially on behalf of electric lighting companies. It is a matter of surprise that a greater number of these companies have not united themselves with the Association, and assisted in the work of looking after their own interests. If the majority of electric lighting companies were connected with the Association, it would be quite an easy matter for the Association to secure a valuable fund of information relating to the conditions under which the business is being carried on throughout the Dominion, and this information could be placed at the private disposal of each company having membership in the organization. We have no hesitation in saying that the Association has not received the support to which it is entitled from the electric lighting companies, and the letter which we publish above shows that the Association is not the only loser in consequence. We trust that during the coming year the electric lighting companies will see it to be to their interest, as well as to the interest of the electrical industries in general, to connect themselves with the Association, and give their support to the valuable work which the organization has already done and aims to do in the future.

The Penetanguishene and Midland Street Railway, Light and Power Co. held its annual meeting recently.

London branch No. 5, C. A. S. E., recently elected officers for the ensuing year as follows: president, Robert Simmie; vice-president, E. Kidner; secretary, W. Meaden; treasurer, F. G. Mitchell; doorkeeper, Wm. T. Modeland; conductor, W. Guymier. The association meets in the Huron and Erie Loan & Savings Co.'s block.

ELECTRIC RAILWAY DEPARTMENT.

THE WINNIPEG ELECTRIC STREET RAILWAY COMPANY.

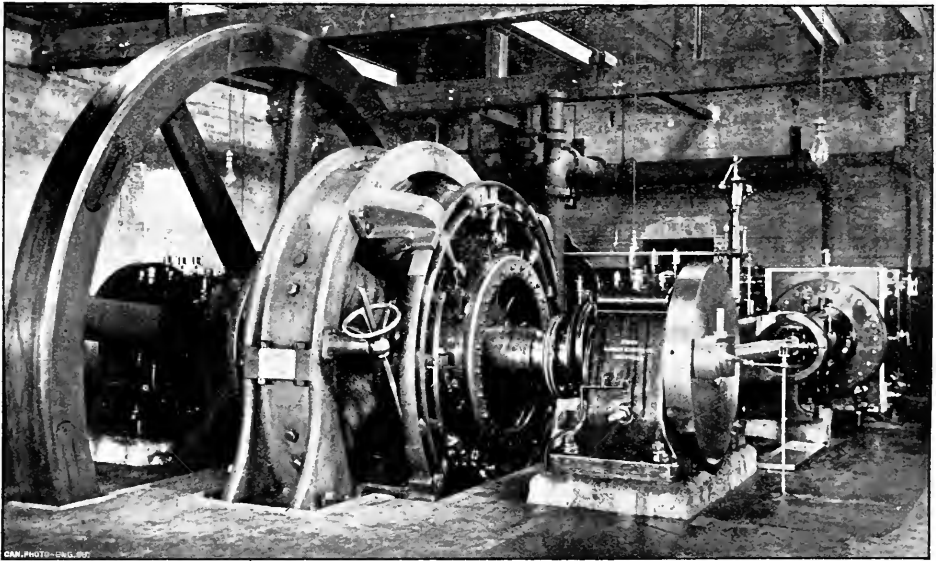
WE referred briefly in a recent issue to the successful starting up in the power house of the Winnipeg Electric Railway Company of the third large direct connected generator so far installed in Canada. This notable example of the progressive spirit of the company and of their determination to keep abreast of the times was made the occasion of a very pleasant recognition of their enterprise on the part of the civic dignitaries and of the local press. We are pleased at this opportune moment to be in a position to place before our readers a more detailed description of this installation and of the company's system in general.

The Winnipeg Electric Street Railway Company was organized in 1891 with a capital stock of \$300,000, to construct and operate an electric street railway system under the franchise offered by the city of Winnipeg, the personnel of the company being practically identical with that of the street railway syndicate by which the franchises in Toronto, Montreal, St. John and elsewhere have been exploited. On the directorate are included such well known

protect their interests by the more active and direct method of paralleling one another's lines and of cutting down rates.

However, the decision of the Privy Council in the city's favor opened the way for the absorption of the horse-car system by the Electric Street Railway Company, and gave back to the citizens of Winnipeg at least a partial possession of their streets, which was welcomed even at the price of an increase of the fare to a more reasonable basis. Since that period the attention of Mr. Campbell, the energetic manager of the company, has been devoted to affecting such improvements in the physical condition and operation of the road as would render their service at least equal to that given in any city of similar size on the continent. The policy of the company in this respect is based on the conviction that their equipment and service, while admittedly in excess of the present requirements of the city, will be found in the near future no more than sufficient to meet its certain and rapid development and increase in population.

A description of the plant and equipment of the company embodies many features of interest. The power house is a substantial



WINNIPEG ELECTRIC STREET RAILWAY—600 C. G. E. CO. DIRECT CONNECTED GENERATOR.

names in Canadian railway and financial circles as Sir Wm. Van Horne, James Ross, Wm. McKenzie, R. B. Angus and T. G. Shaughnessy. Mr. G. H. Campbell, of Winnipeg, who had been largely instrumental in forming the company, was appointed manager, and at once set to work on the construction and equipment of the road.

The company's operations at the outset were to a certain extent hampered by the fact that their franchise, while in other respects sufficiently favorable, did not give them exclusive possession of the streets of the city, which had for some years been occupied by the Winnipeg Street Railway Co., operating a horse car system. This company, of which Mr. Jas. Austin, of Toronto, was the principal stockholder, had relied on the assumed exclusive nature of their franchise in refusing to accede to the terms of the agreement under which the city was willing to allow them the privilege of converting into an electric system. Under these circumstances the granting of a franchise to the new Electric Street Railway Company was the signal for a bitter and protracted legal contest, which ended finally in a decision of the Privy Council adverse to the Winnipeg Street Railway Company's contention of an exclusive right under their charter, and fully admitting the validity of the city's action in granting to the new company the franchise for an electric system. Naturally enough pending the final settlement in the courts of their status from a legal point of view, the companies were not idle in their efforts to

brick building on the bank of the Assiniboine river, from which an ample supply of water for condensing is at all times readily obtainable.

THE BOILER ROOM.

The boiler room is a brick building, 82 x 42 wide, with an iron roof 18 feet from the floor. The floor is five feet below the engine room floor. In the boiler room are four boilers 17 feet 4 inches long, by 72 inches diameter, which take up just one half of the space enclosed, so that when occasion demands it the plant can be duplicated, without increasing the size of the building. These boilers were built by the Bertram Co., of Toronto, and are used at a working pressure of 130 lbs.

The draft for the boilers is given by an octagonal stack 150 feet high by 6 feet inside diameter. In this chimney are 167,000 hard white brick and 8000 fire brick, which rest on a base of concrete 26 feet square by 10 feet deep, and this again rests on two hundred 25 foot piles.

One of the features of the boiler room is an electric damper regulator, by means of which the steam pressure is kept within 2%. The Holly system is connected to the steam piping, for returning by gravity to the boilers the condensed steam in the pipes.

ENGINE AND GENERATOR ROOM.

The engine room is a brick building, with stone foundation 82 x 56. On the left hand side of the main entrance are the 30 horse power high speed engine and 30 k. w. Edison bi-polar 500 volt

generator, that the old company used for running three cars in Fort Rouge. They are used now for lighting the car shed and power house at night, after shutting down the large plant, and also for lighting the parks in summer. On the right hand side is the cross compound, surface condensing Wheelock engine, which was installed five years ago, and has been used up to the present for running the whole system. The engine drives three 100-kilo-watt Canadian General Edison type bi-polar machines coupled by means of a countershaft to a 16 foot \times 36" face fly wheel.

Across the room and occupying just one half the space of the old plant is the new Laurie direct coupled cross compound Corliss engine and Canadian General Electric 400 kilo-watt 8 pole generator. The cylinders are 18" and 34" dia., 42" stroke, steam jacketed. The armature of the generator is pressed on an 18" shaft and runs at 90 revolutions per minute. Double eccentrics on each engine allow for carrying the steam for any part of the stroke. The following are some of the dimensions and weights: The fly wheel is in eight sections; it is 18 feet in diameter and weighs 25 tons; the crank shaft is 18 inches in diameter and weighs 11 tons; the armature is 66 inches in diameter and weighs 18 tons; the whole engine and generator represent 125 tons, resting on a concrete base 40 \times 28 laid on piles with a brick and cement foundation; the revolving weight is 106,000 lbs. A surface condenser is used of cylindrical shape, with 1,200 square feet of cooling surface, and a twin vertical air pump of the Blake pattern, 12 \times 18 \times 12.

The feed pumps consist of one duplex centre packed double plunger pump 8 \times 5 \times 12, of the Northey pattern, one duplex circulating pump 10 \times 14 \times 12, of the same make. An automatic safety governor is provided on the throttle valve to cut off steam if the engine runs faster than 100 revolutions.

GENERAL INFORMATION.

The company operates 16 miles of track, 1 $\frac{1}{2}$ miles of which is double, laid with 56 lb. T rails. The rolling stock consists of 24 motor cars, 10 trailers and 7 excursion cars. The equipments are made up of 15 of the No. 14 Edison double motor type, 4 No. 3 Westinghouse and 5 improved Sprague.

As might be expected, ample provision is made for handling the snow-fall which, while not to be compared with that of Montreal or Ottawa, is still considerable, the equipment for this purpose consisting of a revolving broom sweeper and a West End snow plow.

In connection with the excursion cars mentioned above it might be added that a most important addition to the company's revenue comes from the operation of an excursion route to Elm Park, a charming recreation ground owned by the company on the banks of the Red river about 3 miles from the Fort Rouge suburb of the city. The excursion cars mentioned are supplemented by band cars, which can be specially decorated in a manner suitable for the particular occasion, and which have proved a drawing card of great value for gala days and special celebrations.

The electrical engineer of the road is Mr. Herbert J. Somerset, and the chief engineer in charge of the power plant is Mr. Walter Alexander.

MR. GEO. H. CAMPBELL.

The present excellent physical condition of this valuable property is due in the largest measure to the energy and perseverance of Mr. G. H. Campbell, who has been manager of the road since the inception of the enterprise. Like so many of the representative business men who are building up a greater Canada between the banks of the Red River and the Rocky mountains, Mr. Campbell belongs originally to the maritime provinces, having been born in Colchester, N. S., in 1858. Some early experience in railway work was gained during the construction of the Intercolonial, with whose Road Department he was afterwards for some time connected. In 1879 Mr. Campbell went west and was engaged on the construction of section B of the C. P. R., with headquarters at Rat Portage. Subsequently he filled the position of cashier of freight department, and of city ticket agent for the C. P. R. in Winnipeg, and was in 1890 appointed general immigra-

tion agent, with headquarters in that city. In 1891 Mr. Campbell, realizing the favorable opportunity which the dead-lock between the existing company and the city offered for securing a favorable franchise for an electric road, succeeded in interesting the necessary capital in making an agreement with the city under which the system of the Winnipeg Electric Street Railway Company has since been successfully installed and operated.

THE GALT AND PRESTON ELECTRIC RAILWAY.

The Galt & Preston Electric Railway has been extended to within half a mile of the town of Hespeler, and communication will shortly be completed to the centre of the town. The company have installed an additional generator of the C. G. E. type, and have added to their car equipment, to accommodate the extra business arising out of the extension of their lines. They have also constructed a commodious car barn adjoining their power station. A representative of the ELECTRICAL NEWS, who visited Preston recently, was informed that for some time after the system was put in operation, the freight business was so extensive that the profits therefrom were sufficient to cover, not only the operating expenses of the road, but also interest charges on the capital invested. A large part of this business consisted in the carrying of coal. Unfortunately for the company, however, the G. T. R. Co., who, previous to the construction of the electric road reaped the profits of this service, has found means to recover it. It is a well known fact that under its agreement with the Railway Association, the G. T. R. is not allowed to cut rates, but the company have got around the difficulty in this case by making no charge for cartage.

The passenger business on the electric road has also been most satisfactory. The company have purchased a park half way between Preston and Galt, which during the past summer was largely used by the citizens of both towns as a pleasure resort, and which was the means of largely increasing the company's revenue.

THE OLDEST STEAM ENGINE.

An old Newcomen engine near Bristol, England, is, perhaps, the oldest steam engine now running. It seems to have been built about the year 1745, according to Engineering, and is still employed about five hours a day for pumping water from a coal-pit. The cylinder is 5 $\frac{1}{2}$ feet in diameter, and the piston has a stroke of six feet. The engine has a beam 24 feet long and about 4 feet deep, built up of many oak beams trussed together, and works with a curious creaking noise. The total weight is about five tons. Steam is now taken from boilers in a neighboring establishment, the pressure being reduced for this engine to 2 $\frac{1}{2}$ pounds. The indicated horse power is only 5 $\frac{3}{4}$. The old man who attends to the engine has driven it since he was a boy, and his father and grandfather worked it before him.



MR. GEO. H. CAMPBELL.
Manager Winnipeg Electric Street Railway.

PERSONAL.

Wm. Gray, representing the Magnolia Metal Co., New York, was in London lately. He reports business good.

J. B. Crawford, a former policeman in Ingersoll, has been appointed manager of the Metropolitan Telephone Company in New York.

Mr. G. L. Schafer, foreman of the construction gang of the Bell Telephone Co. at Kingston, has been presented with a gold ring by the men under him.

Mr. W. McCammon, a crack football player, of Queen's University at Kingston, has taken a position in the electrical supply manufactory at Syracuse, and has left the football field.

Mr. W. F. McLaren, of Hamilton, Ont., electrician, with the Westinghouse Electric Manufacturing Co., Pittsburgh, Pa., has recently recovered from an attack of typhoid fever, and has resumed his duties.

Gus Farlinger, an electrician, employed by the Oswegatchie Light & Power Co., at Gouverneur, was nearly killed by an electric shock recently while repairing a broken wire. He fell 60 feet to the ground and sustained serious injuries. About 1700 volts passed through his body. Mr. Farlinger was a former resident of Morrisburg, Ont., and was at one time with the Royal Electric Company.

PUBLICATIONS.

Through the amalgamation of the The Methodist Magazine and Canadian Methodist Review under a combined title, the best features of both periodicals will be united, and important departments added, without any increase in price.

Cassier's Magazine for January is essentially an electrical number. It contains a variety of articles on the most important and timely engineering subjects of the present day, the latest developments in applied electricity, the latest realizations of electric power transmission and utilization, and the possible achievements of the near future having all received attention.

The Arena, one of the ablest reviews now published, has issued its prospectus for 1896, in which it promises its readers a rich store of articles by some of the best thinkers of the day. Social, ethical, economical, political, educational, scientific, religious and physical problems of the day will be discussed in its pages, and the names of its contributors certainly make a most attractive array. We notice among the good things promised, which will be of special interest to readers of the ELECTRICAL NEWS, articles on national monopolies and the people, among which will be one by Prof. Frank Parsons, of Boston, on Municipal Lighting. Commencing with the December number the Arena has been reduced in price from \$5 to \$3 a year. The Arena Publishing Co., Boston, Mass.

A complete and immediate revolution of transportation methods, involving a reduction of freight charges on grain from the west to New York of from 50 to 60 per cent., is what is predicted in the Cosmopolitan. The plan proposes using light iron cylinders, hung on a slight rail supported on poles from a cross-arm—the whole system involving an expense of not more than fifteen hundred dollars a mile for construction. The rolling stock is equally simple and comparatively inexpensive. Continuous lines of cylinders, moving with no interval to speak of, would carry more grain in a day than a quadruple track railway. The Cosmopolitan points out the probable abolition of street cars before the coming horseless carriage, which can be operated by a boy on asphalt pavements at a total expense for labor, oil and interest, of not more than a dollar a day.

PATENTS PROCURED ON
ELECTRICAL INVENTIONS

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TOPPINS,

SIDE-BLOCKS

AND CROSS-ARMS.

WRITE FOR PARTICULARS.

SPARKS.

Work has been commenced on the Napierville Junction electric railway.

The Ottawa Electric Co. is considering the building of an ambulance car.

A new style of chain for bicycles has been invented which will drive them at the rate of 50 miles an hour.

A gigantic strike of street car men took place in Philadelphia in December. Most of the roads were tied up.

Work has been commenced at St. Remi on the new electric road to be built between that place and Scottsville.

The hatching of eggs by electricity is being carried on in Germany on an extensive scale, and is proving very successful.

The Chinese Government has issued an edict ordering the construction of a double track railway between Peking and Tien Tsin, a distance of 72 miles.

To show what observation and study will do for young men, we may state that Mr. N. B. Chant, of Clinton, Ont., with what knowledge he has acquired by reading, has built a 1 h.p. dynamo, with which he lights a department of the Doherty organ factory with 50 lights. He also built a regulator and volt meter, and they show his neat workmanship.

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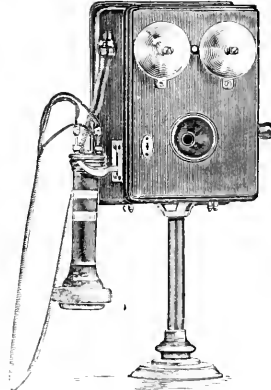
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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VI.

FEBRUARY, 1896

No. 2.

MR. E. E. CARY.

THE annexation of the United States to Canada is proceeding satisfactorily. Our latest conquest in this direction is the capture of Mr. E. E. Cary, the newly appointed manager of the Packard Electric Co., of St. Catharines, whose portrait we have pleasure in being able to present to the readers of *THE ELECTRICAL NEWS*.

Mr. Cary's home since infancy has been in New York City, although he has not resided there continuously. He graduated from the Polytechnic, of Brooklyn, N. Y., in 1884. During 1883-4 and part of 1885 he was public and private assistant in electrical work to Prof. Robt. Spice, of Brooklyn, N. Y. In 1885 he entered the laboratory as assistant in electricity and chemistry to Prof. Weston, then connected with the old U. S. Electric Light Co., of Newark, N. J. In this position he remained three years, devoting much time to the development of incandescent lamps, then in its early infancy as a commercial product. He then accepted an opening with the Westinghouse Electrical Mfg. Co., of Pittsburg, where he remained for two years and a half. While with the Westinghouse Company he was associated for a year with the Russian physicist Dr. Lodyquin in special filament investigation, having to do with high efficiency lamps. He then joined the forces of the Sawyer-Mann Electrical Co., and did special experimental and practical work on 110 volt lamps.

For the past four years he has been connected with the Beacon Vacuum Pump & Electrical Co., of Boston, as superintendent, and latterly as business manager. In December last he joined the Packard Electric Co., Ltd., as general manager. The most of his work in the States has been intimately associated with the development of the incandescent lamp.

Mr. Cary is the author of a number of inventions, having to do with the mechanical and scientific production of the incandescent lamp, and was one of the inventors of the N. and C. Stopper lamp, which, though ultimately not proving a commercial success, owing to its being pushed on the market too soon, involved new principles which some day may be most valuable. It is protected by over 20 patents, issued in the U. S.

It will thus be seen that Mr. Cary is well qualified for the position he now occupies, and the Packard Company are to be congratulated upon having obtained the benefit of his experience and services.

ELECTRIC LIGHT AMALGAMATION IN TORONTO.

THE negotiations which have been in progress for some time past with the object of effecting a closer business relationship between the Toronto Electric Light Co. and the Incandescent Light Co., of Toronto, are understood to have resulted in an amalgamation of the interests of these companies. The bulk of the stock of the Incandescent Company has passed into the hands of the Toronto Electric Light Company, while on the other hand, several of the directors of the Incandescent Company have acquired stock in the older Company, and will occupy seats on the Board of Directors of the amalgamated concerns.

It is stated that Mr. Frederic Nicholls, the organizer and manager of the Incandescent Company will shortly retire, and the management of the amalgamated concerns be placed in the hands of Mr. J. J. Wright, the present manager of the Toronto Electric Light Company. It is believed that Mr. Nicholls will be a Director of the new Company.

Authority will be sought to enable the company to increase its capital stock to at least \$1,500,000.

The improvements designed to be carried out by the Toronto Electric Light Company before the amalgamation, including the building of a new station and the installation of an alternating incandescent lighting plant, are being proceeded with. A large power alternator of the C. G. E. type has already been purchased. A test is to be made of Stanley and Monocyclic machines for incandescent lighting, and the system which gives the most satisfactory results will be adopted.

The current generated at the incandescent station on Terauley-street will probably be exclusively used for lighting the business district of the city, while current for power and incandescent lighting in the residential parts of the city will be furnished from the new station, shortly to be erected on the esplanade.

The Vernon & Nelson Telephone Co., have extended their service to Trail and Rossland, B.C.

The Canadian Marine Engineers' Association have elected officers for 1896, as follows: President, O. P. St. John; First Vice-President, J. S. Adam; Second Vice-President, J. Parsall; Council—J. Findlay, R. Hughes, S. Gillespie, D. F. Campbell, R. McLaren; Treasurer, D. L. Foley; Secretary, S. A. Mills; Auditors—R. Childs, J. H. Ellis; Inside Guard, E. Abbey.



THE RECENT SLEET STORM.

The recent sleet storm which resulted in so much damage to the electrical interests throughout the country, and especially in the City of Toronto, which appeared to be the centre of the storm, was indirectly an illustration of the old saying that "every dog has his day," inasmuch as it furnished a harvest for the hack-

mense destruction to their system has given rise to the opinion, on the part of the public, that in the interests of the company and its subscribers their wires should be placed underground. On the surface this would seem to be a proper view of the matter, but further consideration will show that there are serious difficulties in the way of carrying out the proposition. In the central part

of the city, where hundreds of subscribers are bunched together within a limited area, it is possible to place the wires underground, as they can easily be brought up through cables to the top of a pole or building, and from thence distributed to subscribers. This is not the case, however, in the out-lying districts, where subscribers are more widely separated from each other. In such districts poles are an absolute necessity for distribution purposes. If there is any means of distributing current to subscribers in such districts, without the aid of poles, we would be pleased to learn how it could be done.

The opinion has also been expressed that the telephone company made a mistake in adopting

the trunk line system of distribution, by which they are obliged to carry from 100 to 200 wires upon their poles, the weight of which, with the addition of a coating of ice, is calculated to cause the poles to give way under a storm such as we have just experienced. It is a singular fact that in the recent storm there are said to have been more broken poles with five cross arms and under than with five cross arms and upwards. It is somewhat

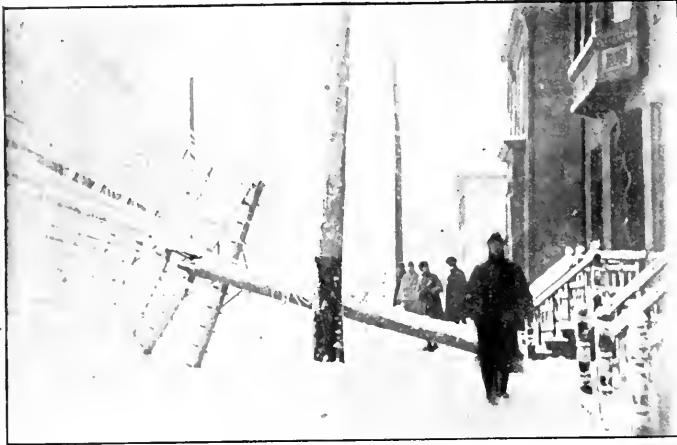
men at the expense of the Street Railway Company. The storm proved even more disastrous to the electrical companies than the one which took place a couple of years previous. We publish herewith some illustrations which will serve to indicate the destruction wrought in Toronto, and the difficulties with which the electrical companies had to contend and are still contending in consequence. For the photographs from which these illustrations were made, we are indebted to Mr. Arthur M. Rust, of the City Engineer's department.

By far the largest amount of loss fell upon the Bell Telephone Co., owing, no doubt, to the fact that its poles were much more heavily laden than those of the electric light and telegraph companies. The latter appear to have come out of the occurrence with comparatively little loss.

The Great North Western Telegraph Company's lines west of Toronto were in operation before noon of the day following the storm. The greatest difficulty the company experienced was in the vicinity of Scarborough, where its wires and poles were so heavily sheathed with ice as to be unable to withstand the strain.

The Electric Light Co., after consulting with the city authorities, deemed it inadvisable to turn on current on the night following the storm, lest accident might result on account of the tangled up condition of the wires on the streets.

The Bell Telephone Company's loss is estimated to be somewhere between \$50,000 and \$75,000. The im-



SAMPLES OF THE WORK OF THE RECENT SLEET STORM.
Ontario Street, looking north from Queen Street, Toronto.



SAMPLES OF THE WORK OF THE RECENT SLEET STORM.
Rose Avenue, looking north from Winchester Street, Toronto.

difficult to account for this fact seeing that each additional cross arm, with its attendant wires, must increase the weight on the pole. It should be borne in mind, however, that each additional cross arm is located lower upon the pole and tends to distribute the weight.

It seems to be rather a question of the direction in which the pole lines run, and the amount of shelter they

get, than the number of wires they carry. As to shelter, they get very little, owing to the fact that the poles must be high enough to place the wires beyond the reach of contact with shade trees and buildings. It has been found that the lines running east and west suffer comparatively little as compared with those running north and south. Unfortunately it is not possible for the Telephone Company to run its lines in one direction only, as might be done by a telegraph company seeking an outlet into the country. The Telephone Company are obliged to go where its subscribers are, no matter what the direction may be. Referring again to the trunk line method, it may be pointed out that the adoption of this method in Toronto was also necessitated by the fact that the company's agreement with the city prohibits them from using certain of the principal thoroughfares, so that it becomes necessary for them to mass their wires on certain streets in order to be able to reach their customers.

It has likewise been suggested that wrought iron should be substituted for wood for poles, but the persons who make this suggestion have evidently not considered the question of cost. In Belgium, where iron and labor are cheaper than almost any other place in the world, the cost of wrought iron poles 100 feet high is about \$800 each. A similar amount would have to be paid on this Continent for a pole 62 feet high, which is about the height of the wood poles now in use by the Bell Telephone Company in Toronto. These wood poles probably cost the company not more than \$10 each, so that it can readily be seen that the use of iron is entirely out of the question. It may be possible at some future time to evolve a method of distribution which will be equally as efficient and less subject to unfavorable weather conditions than that at present in use, but so far the problem remains unsolved.

The recent storm serves to indicate the necessity for a large reserve fund on the part of electrical companies in general, and telephone companies in particular. It would of course be unreasonable to assume that such a storm is likely to occur every second or third year. Prior to the storm of two years ago there had not been such an occurrence for 12 or 15 years, and possibly there may not be another for a like period in the future.

The purchase of the electric light plant of the city of Kingston, Ont., will probably be considered by the council at an early date. The cost for lighting the streets under the present contract is \$7,000.

At Windsor, Ont., recently, Judge Horne decided that the municipalities cannot assess the telegraph wires of the Canadian Pacific railway, as the company is, by its charter, allowed to erect and maintain telegraph lines and to charge for messages sent by them.

LIGHTING FROM STREET RAILWAY CIRCUITS.

A correspondent writes us as follows:

"In asking the citizens of a certain town in north-western Ontario for subscriptions to help forward a scheme for an electric railroad, they were informed by the promoter that when the road was built, current would be supplied for lighting purposes at the rate of fifty cents per year for each 10 c. p. lamp, and ten dollars per year for each arc street lamp. If 700 lamps were installed, this would in addition to 8 street arc lamps amount to the sum of \$430 per year, which would not go far in paying the expenses of the plant, even if the lighting was done off the trolley wire, which is prohibited by the Underwriters' Association. However, at this rate the electric lighting companies will have to "shut up shop" and start farming or some other congenial occupation. Evidently the aforesaid gentleman was trying how much he could make some people swallow without causing them to gag. He must have succeeded beyond his wildest expectations."

We may say, with reference to the above communication, that electric lighting companies have little to fear from the competition of electric railway companies, inasmuch as the Underwriters' Association, as stated by our correspondent, will not approve of current being taken into buildings for lighting purposes from street railway circuits.

This matter came up in To-

ronto some time ago, with the result that owing to the opposition of the Underwriters' Association, there is at the present, so far as we know, only one instance to be found in the city, of electric light being furnished from the street railway circuit. There is the additional fact that owing to the frequent and great fluctuations in the current on street railway lines, it is impossible to get satisfactory lighting from this source. These two causes are sufficient in themselves to prevent the extension of electric lighting from street railway circuits, so that electric lighting companies need be under no apprehension of losing their business as the result of the competition of street railway companies.

All these difficulties, of which we hear complaint, are evidence of the need of organization and interchange of views and experiences on the part of those engaged in the electric lighting business.

Professor Waddell, of the Royal Military College staff, Kingston, recently delivered a lecture in the Y. M. C. A. hall in that city on "The Electric Current." With the aid of a battery, small dynamo, magnets, volt and ampere meters, he gave in detail the origin of the electric current and the manner in which the pressure and flow were kept constant.



SAMPLES OF THE WORK OF THE RECENT SLEET STORM.
Terauley Street, Looking North from Louisa Street, Toronto.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

N. 11. Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO NO. 1.

The members of the above association have felt for some time past the necessity of procuring more satisfactory rooms in which to hold their meetings. These have now been secured at No. 61 Victoria street, and consist of one large meeting room, with library room and several anti-rooms adjoining. They are suitably adapted to the requirements of the association, and realizing this, a five-year lease has been secured.

The trustees of the hall are Messrs. James Huggett, E. J. Philip and Geo. Fowler. The inaugural opening took place on the 23rd of January, and was made the occasion of a social entertainment, at which, notwithstanding the inclement weather, upwards of 150 persons were present, many of whom were ladies. The accompanying illustration shows the interior of the main hall.

A concert formed an enjoyable feature of the evening's entertainment, the proceedings being presided over by Mr. W. Lewis, president of the association. The programme, which was entirely voluntary, was as follows: Song, Mr. Thos. Seaton; calisthenics, Mr.



INTERIOR VIEW OF HALL, TORONTO NO. 1, C. A. S. E.

H. Eversfield; trio, Mrs. Coutts-Bain and Messrs. Towers and Cashmore; comic song, Mr. Allcott; duet, Messrs. James Fax and G. W. Grant; song, Miss Warnock; comic song, Mr. Jas. Fax; phonograph, Mr. Parks; song, Mr. W. G. Blackgrove; comic song, Mr. Fax; song, Mr. Cashmore; song, Mrs. Coutts-Bain; duet, Miss Warnock and Mr. Grant; concertina solo, Mr. Vaughn. A decided hit was made by Messrs. Fax and Grant in a duet entitled "Goodness Gracious." For the benefit of absentees we give one of the verses:

When Wickens first started the C. A. S. E.,
Oh, goodness gracious,
Folks thought he was off of his b-a-s-e,
Goodness gracious;
But now we've got Edkins and Phillips too,
George Mooring, Tom Eversfield, doodle-dum-doo,
And then as a climax this hullabaloo,
Gracious, good gracious, goodness gracious.

A brief address was delivered by Mr. A. M. Wickens, in which he referred to the circumstances which led to the formation of the society nine years ago. Previous to that time an average of 312 persons were killed each year in the United States and Canada by the explosion of boilers. These explosions were not accidents, but were the result of ignorance and carelessness. It was

therefore decided to make the society, as much as possible, educational in character. At the end of the first year forty members had joined, and in the 3rd year an executive council was formed. Now upwards of twenty branches of the organization are established, and Toronto No. 1 alone numbers about 120 members. At present the association is working under a permissive law, but it was hoped at an early date to obtain a compulsory law.

The President stated that they were desirous of compiling a library, and already a number of books had been promised. It was the intention to invite manufacturers to supply books.

A bountiful supper had been provided which occupied the attention of the guests for some time, after which dancing was engaged in.

The committee appointed to act in conjunction with the trustees, and to whom the success of the evening's entertainment is largely due, consisted of Messrs. G. C. Mooring, chairman, T. Eversfield, C. Moseley, S.

Thompson,
W. G. Allen
and A. M.
Wickens.

HAMILTON NO. 2.

The members of our association are becoming more earnest towards education. To this end we have provided ourselves with models, books etc., besides having an indicator of our own for the use of any of the members.

We have started our regular instruction meetings, and they promise to be of great benefit during the winter months. At the first of these meetings the Recording-Secretary read a paper illustrating the application of Ohm's law, which will be sent you for publication in the March issue of your journal. At the last meeting some good discussions took place on pumps, also on the proper area of steam and exhaust ports, which will no doubt be continued.

WM. NORRIS,
Recording-Secretary.

BROCKVILLE NO. 15.

Wm. Robinson, Recording-Secretary, writes: The members are taking a lively interest in the meetings and the work, especially the educational part. Our membership is about twenty-four, and taking the average attendance it is really good. We meet on Mondays for regular business, and on Fridays our time is devoted to educational matters. It is the intention of the Executive Committee, I believe, to procure models for the different associations, which will no doubt make a great many things more comprehensible. I trust they will be received before long.

ANNUAL DINNER OF MONTREAL ASSOCIATION NO. 1.

The sixth annual dinner of the above Association, held at the Queen's Hotel, on the 30th ult., was attended by about 120 persons, and was perhaps the most successful event of the kind in the history of the Association. Mr. J. J. York, President of the Association, presided, having on his immediate right and left the following invited guests: Prof. Nicholson, of McGill University; Lieut.-Col. Massey; Messrs H. R. Ives, Walter Laurie, Lieut.-Col. Stevenson, Chas. Morton, A. Henry, J. Dyer, Wm. Laurie, D. W. McLaren, O. E. Granberg, J. C. Willison, Chas. T. Smith, J. C. Holden, H. Valance, P. Cowper, Thos. Ryan, Geo. Kell and W. T. Bonner.

There were present the following members, in addition to fifty friends who bought tickets:—Past Presidents, Messrs. Jos. G. Robertson, Ryan and Hunt; B. A. York, H. Nuttall, Robt. Doran, Gerry E. Flannigan, J. E. Huntington, John Robinson, A. Mesnard, H. Rollins, E. Hay, Wm. McHalpin, Wm. Allan, H. W. Smith, Wm. Burgess, Chas. Sanderson, Jos. Badger, John H. Garth, J. S. Campbell, J. Glennon, Alfred Ward, Jos. McParlon, Jas. Wilson, H. J. Weaver, John Smyth, J. E. Jones, John Burns, J. Kirwin, Chas. Casey, Jas. Morrison, F. D. Jones, A. W. Brown, Wm. Ware, Geo. White, Wm. Norket, Jas. Elliott, J. B. Goulet, Ed. Orton, David White, J. V. N. Cecey, E. Valiquette, B. D. Tierman, Wm. Bill, John Murphy, Hugh Thompson, D. Smitherman.

Letters of regret were read from the following: S. C. Stevenson, Secretary Council of Arts and Manufactures; Wm. H. Browne, Manager Royal Electric Co.; Jas. H. Peck, Peck, Benney & Co.; A. Ramsay, A. Ramsay & Son; G. C. Cunningham, Manager Montreal Street Railway Co.; Henry Holgate, Manager Montreal Park & Island Railway; W. S. Blackgrove, President Executive Council, C.A.S.E.; John Thorpe, Pilkington Bros., Ltd.; James Jackson, Manager Dom. Cotton Mills Co.

After a proper amount of attention had been paid to the excellent menu, the Chairman addressed the assembly as follows:—

"We have now arrived at that part of the proceedings where I trust everyone has sustained a serious loss of appetite. We have also arrived at the point where the Chairman is supposed to say something short and sweet, and let the business of the evening proceed.

"With my brother engineers, I feel highly honored to have the company of so many of the largest steam-users in the city of Montreal, as well as the presence of representatives of two of the greatest educational institutions in Canada—the McGill University and the Council of Arts and Manufactures. We also feel honored by the presence of an old friend, in the person of the Chairman of the Fire Committee, and the many other gentlemen who have so kindly consented to contribute to our entertainment. But it is for the benefit of steam-users particularly that I wish to make a few remarks. I am sure that not one quarter of the steam users of this city know the aims and objects of this Association, and much less about the noble work it has in hand. On the other hand, there are large steam-users here to-night who are pleased to know that there is such an Association, and who can tell you that the Association is directly responsible for the more economic operation of their steam plants. And why? Because it has assisted to educate their engineer, and the engineer has helped to educate others.

"A few words here descriptive of our methods may not be out of place. This Association was formed in the year 1883—about the same time that the question of licensing engineers was before the Council—and at a regular meeting held in the St. Lawrence Hall on Aug. 19th, 1885, Thomas Ryan in the chair, a resolution was passed, the like of which no other body of men has since passed. It recommended an increase in proposed examination fee, or tax, on engineers. This is proof that the only fault we had with this license law was that it was not strict enough. The next few meetings were employed in the work of organization and the framing of by-laws, &c. On Nov. 10th of the same year W. H. Nuttall read the first paper before the Association, entitled "Priming—Its Causes and Prevention." This was the key note, and at every meeting since, with but few exceptions, some subject pertaining to steam engineering has been taken up and discussed.

"This Association is now composed of about 95 members, and includes some of the best engineers of the city. We are possessed of working models, instruments and apparatus to the value of \$700; furniture, carpets, &c., \$250, and are just about to close an order for \$150 worth of books for our library, which, thanks to our friends, already contains several valuable works. If we could only educate the steam-users of this city to take us into their confidence and make the changes suggested by us, and afterwards

pay us 25% of the saving effected, I will say without fear of contradiction that we would in less than ten years own a building larger and grander than this Queen's Hotel.

"Now Mr. Steam-User, don't think for a moment that we are after your money. Quite the contrary. We are this very day saving you money; all we ask is that you look upon your engineer as a man of responsibility, a man who holds the safety of your factory and the lives of all employed in it in his hands. We would also ask you to keep in view the fact that he has it in his power to increase or decrease your profits as he likes by way of the coal pile. You may think this strange, but I will show you how true it is by telling you something that actually transpired. The owner of a certain factory in this city who did not employ a competent engineer, had from time to time increased the output of his works, and of course the consumption of coal increased also, but in much larger proportion. He paid no attention to this, until one day the engine absolutely refused to longer put up with the treatment received at the hands of the incompetent engineer, and stopped work. An engine builder was called in; he wanted \$75.00 to fix it up, and was told that he wanted more than he would get. He then offered to fix the engine gratis provided the owner would give him the value of the coal the engine would save during a certain time. This was at once agreed to and a contract drawn up, with the result that the engine was soon repaired and that steam user paid to that engine builder upwards of \$160. Now what happened? Did he discharge his engineer for incompetence and secure another that would keep his plant in a state of efficiency? No, he did not; he kept the same man on, and to-day that plant is nearly as bad as ever it was.

Why is it that we find in nearly every factory office an expert bookkeeper at a high salary? It is because the owner knows what good book-keeping is, and wants his books kept in the best possible manner. If he only knew half as much about the engineer's duties, I am very sure there would be many openings for competent men next week.

I must not longer trespass on your time, but will add that we do not admit everybody to membership—in fact, during the past year we have refused several applications because they could not demonstrate that they were competent to take charge of a steam plant. I would also take this opportunity to invite every steam user to become an honorary member of our Association, which they can do on payment of the small sum of \$5.00. This will entitle him to all the privileges that I, or any other engineer enjoy, with the single exception of voting, and will also prove beyond a doubt that nothing detrimental to your interests is discussed at our meetings. Your membership would, I am sure, be of great mutual benefit, apart from the fact that it would very materially assist us in adding to our library or stock of instruments.

The toasts were replied to as follows: "Council of Arts and Manufactures," Mr. W. Laurie; "Faculty of Applied Science," Prof. J. T. Nicholson; "Boiler Inspection" Col. Stevenson; "Fire Committee," O. E. Granberg; "Brotherhood of Locomotive Engineers," Mr. Thos. Clark and Geo. Kell; "Our Guests," Col. Massey, C. M. Smith, C. Morton, H. Nuttall, W. G. Norris, T. Ryan, H. R. Ives, A. Hershey, John Dyer, Wm. T. Bonner, H. Valance, P. H. Copper and W. D. McLaren. Strange to say a champion could not be found to respond on behalf of "Our Tormentors." Several excellent songs and musical selections were rendered by R. Hilliard, J. Dougherty, Dr. Nicholl, W. Morris, W. Campbell and Vice-President Hunt.

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

EDITOR CANADIAN ELECTRICAL NEWS.

DEAR SIR,—During the month of December the following engineers have been examined and received certificates: 1st class, Wm. Gray, Galt. 2nd class, G. B. Risler, London; A. J. House, Sudbury; Thos. Leake, Stratford; J. G. Archibald, Woodstock. 3rd class, Jno. Kappler, St. Marys; R. Hutt, Queenston; J. Wedgerry, Woodstock; J. F. Glenzie, Listowel.

The following engineers who formerly held 3rd class certificates have passed the examination and received 2nd class certificates: Wm. Cole, Thos. Young, D. McKay, and R. Topping, all of Woodstock.

During the month seventeen engineers tried the examination, and thirteen were successful.

I shall be glad to send copy of by-laws, &c., to any engineer who will send request for same on post-card.

Yours truly,

A. E. EDKINS, Registrar.

139 Borden st., Toronto.

A CANADIAN MOTOR-CYCLE CONTEST.

BY ARTHUR W. WHITE, LONDON.

GLANCING through the different scientific papers, one sees considerable discussion and argument about motor vehicles. Some probably through selfish motives publish what they designate a "Conservative Article," and in some instances an editorial dealing with the question. The articles referred to are inconsistent in the extreme, and the only inference to be taken from them is, that their writers are not ready for the advent of motor vehicles. By all means be conservative, but do not allow personal advantages to be the motive.

Among the best methods, in the writer's opinion, for "pushing this good thing along" in Canada, public trials and tests stand well to the fore. New York is agitating one, and France and Germany will hold a number next summer. The last issue of the London, (Eng.) "Engineer" contains full prize list and conditions of a competition for one thousand guineas.

The present English law prohibits a self-propelled vehicle from travelling more than four or six miles per hour, and places further restrictions on this manner of travelling, enough to make a race impossible without special act of parliament, or a revision of turnpike laws, which changes are now being agitated. There seems to be a difference of opinion as to whether a race could be run in Canada, without the same steps being taken. Should this be the case, would it not be advisable to obtain permission, before a Canadian race takes place, otherwise the contestants, or promoters of the trial, could be held responsible for damages arising from frightened horses, etc.

That a Canadian race should take place goes without saying. We must keep up with the times. If there are no public spirited men who can afford to offer sufficient inducements, in the shape of prize money, forthcoming, the race can be arranged in other ways. In Ontario, we have two large fall exhibitions, the Industrial, of Toronto, and the Western, of London. Either of these should be able to make a paying investment of a motor cycle contest; it would certainly be a drawing attraction, more instructive, more entertaining, better advertised and more in keeping with an industrial exhibition, than balloon ascensions, high diving, second-class contortionists and acrobatic entertainments and wild-west and Arab shows, comprised mostly of toughs from the slums of large cities, who hire a few horses, dress in exaggerated costumes, shout and discharge firearms. Half the amount of money paid for this sort of thing, would make a purse sufficient to induce others besides Canadians to compete. It would make an exhibition Industrial in reality, as well as in name. It would stimulate Canadian inventors, as the Chicago race did United States inventors. Previous to the advertising of this race, motor vehicles were almost unknown in the United States. Over five hundred applications for patents, covering motor vehicles and parts thereof, were made during the time intervening between the first notice and the consummation of the race. If five hundred of our best thinkers started to think, it would mean more for Canada than one can imagine. Motor vehicles are only in their infancy. There is room for great improvement, and competitive tests are among the best methods for their improvement.

Preliminary tests, from which the judges could decide the points of internal friction, design, construction, ease of handling, finish, etc., could be held the first four or

five days of the exhibitions, in a building provided for this exhibit. Processions could be given daily in the ring, and a final race starting in the ring, encircling it once or twice, thence to a point twenty or thirty miles into the country and return to finish by again going around the ring. Manufacturers would enter a contest of this kind as much for advertisement as for the prize money, and should, in the writer's opinion, be willing to pay a reasonable entrance fee.

There is no reason why both London and Toronto should not include a motor vehicle contest in their attractions and prize lists, and it is to be hoped that the directors of these exhibitions will give it due consideration. London can offer exceptionally good accommodation. A race from the city to Lucan or Strathroy would be an ideal run—roads that are good in all weathers, with just grades enough to give a good test, and plenty of villages along the route for frequent relay stations.

The vehicles might be divided into two classes, one class for electric motor vehicles and another for carriages driven by internal combustion engines and other small motors, that carry their fuel in small receptacles, enabling them to take enough for the complete trip. The former might show up to good advantage in preliminary tests, processions, and short trips, but, as has been proven by previous races, the latter could make the best time in a long road race.

Should these few rambling remarks, or any personal assistance, be of any value to exhibition directors, or private individuals with a desire to further the advancement of this industry in Canada, the writer will be more than pleased. One thing is certain, the motor vehicle has come to stay, and our country should, as usual, be well to the front in the improvement and manufacture of them.

[The above letter, we believe, expresses the sentiments of many persons who are engaged in the manufacture and development of motor vehicles, as well as a considerable number of outsiders who take sufficient interest in the progress of invention to realize the benefits to be derived from such a contest. It is hoped that this letter will result in promoting a discussion on the most feasible plan of conducting the race. We are pleased to be able to state that the management of the Toronto Industrial Exhibition Association look upon the idea with favor, and are at present considering what steps to take in the direction of assisting to bring about a test in Canada. That such a test would prove a drawing card for the Industrial Exhibition goes without saying. It would seem that the amount of the prize money offered by the Association would be determined to a large extent by the number of probable competitors. On the other hand the number of competitors would depend in some degree at least on the amount of the award. In any case should such a race be decided upon, manufacturers should at once make known their intention of entering the contest. The route of the proposed race will be a matter requiring careful consideration. It is certainly desirable that the test should take place over a road corresponding in character with the highways upon which such vehicles would be required, but whether the Exhibition Association management would consent to the test taking place beyond the boundaries of the fair grounds is yet a matter of doubt. We have reason to believe, however, that this

difficulty could be overcome. The new Board of Directors for the Industrial Exhibition Association will be elected about the middle of February. Nothing definite will be known before that date regarding the attitude which the Association will assume towards the proposed contest.—ED. ELECTRICAL NEWS.]

WM. KENNEDY & SONS, OWEN SOUND.

ONE of the most enterprising firms of to-day is that of Messrs. Wm. Kennedy & Sons, of Owen Sound, Ont., who have been established for upwards of forty years. They have become known throughout the Dominion as manufacturers of the well-known "New American" water wheel, electric water wheel governors, turbine wheels, and heavy mill machinery. The turbines now operating the lock gates at the Sault Ste. Marie canal, recently opened, were manufactured at their factory.

The works comprise two large buildings, one being two storeys high, 200 x 40 ft., and the other a three-storey stone building, 78 x 40 ft., at the corner of

2,080 VOLTS FAILED TO KILL.

WE have received from Mr. J. A. Harlinger, Gouverneur, N.Y., the following additional particulars of the accident of which he was recently the unfortunate victim: On Sunday, Dec. 8th, I was asked to go up a 25 foot pole and cut out the commercial loop of one arc circuit. On this pole there were three arc circuits and two 2080 volt alternating circuits. Having received such a severe shock my memory was affected, so that I cannot remember even going to the pole, therefore don't know how the accident occurred, and for three days after I was unconscious. The alternating current was the only one on at the time, so I must have got across 2,080 volts of a three phase alternator, burning the flesh off the front of my hands, on some fingers leaving the bones as clean as if scraped with glass. My position on the pole was such, the minute I lost control of my body I fell backward and down, breaking my grip on the wires; I fell head first. Striking another wire in the fall somewhat righted my body and prevented my brains being knocked out. I fell on my cheek bone, breaking it



WM. KENNEDY & SON'S FOUNDRY, OWEN SOUND, ONT.

Beech and Stephen streets. The business was originally established by the late Wm. Kennedy, in 1858, the present firm being formed in 1864, and being composed of Messrs. Matthew, Alexander and William Kennedy, jr., the two former residing in Owen Sound and managing the general business, while the last-named resides in Montreal and has charge of the branch in that city. They give employment to between forty and fifty men. They have received several medals for their propeller and water wheels, including silver medals from Philadelphia, Paris and Toronto, several bronze from Philadelphia, and one from the Colonial and Indian Exposition held in London, England. The success of the town of Owen Sound is due in no small degree to the energetic efforts of the members of this firm, who have always been public-spirited in advocating whatever would benefit the town. Mr. Matthew Kennedy is president of the Board of Trade.

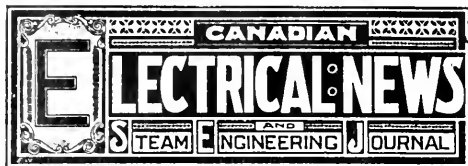
Dr. G. W. Strange and Messrs. J. C. Stokes, L. E. Hambley and A. B. Armstrong are promoting the scheme for an electric railway between Schomberg and Aurora.

A suit has been entered against the Montreal Street Railway Co., by Elizabeth Kerr, claiming damages for \$4,115. It is alleged that she fell while descending from a car on Notre Dame street, tripping on some encumbrance on the step.

in two places and paralyzing one side of my jaw. This fall is all that saved my life as otherwise I consider the doctors would not have been able to resuscitate me. I believe I am the only man who lives to tell of getting 2,080 volts of an alternating current through him.

ELECTRICITY IN PAPER MILLS.

THE extensive works of the Canada Paper Co., of Montreal, situated at Windsor Mills, Quebec, are shortly to be operated entirely by electricity, instead of, as heretofore, by steam and water power combined. The company has developed a large amount of power on the St. Francis river, which will be transmitted to their mills about a mile distant. Here it will be distributed to electric motors ranging in power from 5 h.p. to 150 h.p. each running the various machines. The entire factory will also be lighted with incandescent lamps, and an electric railway is to be constructed from the power house to the mills, for the purpose of carrying pulp. The total amount of power to be transmitted will be about 1,000 h.p. The entire work has been placed in the hands of the well-known electrical engineer, Mr. George White-Fraser, of Toronto, who has just completed a careful survey of the locality, and is now engaged on the specifications. This is the largest enterprise of the kind in Canada, and will, no doubt, be the forerunner of many similar.



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Storage Batteries.

THE storage battery as a central station auxiliary is just now receiving a very great deal of attention at the hands of engineers. A recent meeting of the American Institute of Electrical engineers held in New York was entirely devoted to a discussion of its proper place in central station practice, and the census of opinion seemed to be that the storage battery must be regarded and accepted as a most important and dividend-making necessity. Everyone familiar with the operation of an electric plant will be able to trace out a load diagram for himself. If the capacity of the station is 1,000 lamps, then he will know that from about 5 p.m. till 8 or 9 p.m. every lamp will be going, but that from 9 p.m. till midnight he will not have more than a fifth of full load. Now every educated steam user knows that an engine or dynamo works most economically when it is doing its full rated work, and that in proportion as it's load becomes lighter, so does it's efficiency become less, so that the operation of a plant at one-fifth load is a most uneconomical necessity. Any device, therefore, which will permit of machinery being operated at full load for a considerable proportion of it's running time is worthy of very careful examination, and such a device is the storage battery. During the period of very light lamp load, the battery may be charging, thus bringing up the station load line to full capacity, and when the short period of very heavy load is reached the battery and the dynamo may be thrown into multiple on bus bars, each taking it's proportion of load. At present, the dynamo and engine capacity of a station must be

sufficient to cope with the maximum load that can be placed on that station, so that whereas the average load is perhaps less than 500 lamps, the dynamo, etc., must have a capacity of 1,000 lamps for the sake of the two or three hours of heavy load, and be run all the rest of the time at a most inefficient rate. Now, if the station plant consisted of say a 700 light dynamo and a storage battery with a capacity of 300 lights for four hours, then from about 11 p.m. until shutting down time, when probably not more than 300 lamps would be burning, the current for the other 400 lamps could be used to charge the battery, allowing the engine and dynamo both to be operated at full load. At starting up time again next day, when all 1,000 lamps were required, the storage battery (which was fully charged last night) and the dynamos could each be called upon to take care of their proper shares. The dynamo and engine would still be run at full load, and therefore highest efficiency. In this way it is seen that, first, the steam and dynamo plant need only be of 700-light capacity, instead of 1,000-light, and will run most of the time at or near full load. It is true that a storage battery requires a direct current to charge it, but instances can be referred to when alternating dynamos have been used with a rectifier for the purpose, with perfect success. We shall refer to this matter again.

Motors for Single Phase Alternating Currents.

THERE are a great number of central stations throughout Canada that could very profitably operate a day load of small motors in factories, saw mills, stores, etc., but which have been precluded, hitherto, from working up such a business because their machinery was single-phase alternating, the current from which could not satisfactorily be used for power purposes. A single phase alternating motor will not start up with a load on, which defect, of course, renders it useless. Mr. C. G. Bradley, however, has elaborated a method of splitting up a single-phase E.M.F. into any number of symmetrical phases, with the view of overcoming this commercial disability of the single-phase alternating machine. The method is somewhat complex to describe, involving the use of condensers and inductances, but the results reached seem to be very satisfactory, and hold out the reasonable hope that alternating current stations may be able to work up, and avail themselves of a very profitable power business, without requiring to change the type of their machinery. Of course the method of "transformation of phases" involves some small losses which are eliminated in a properly constructed two or three phase system; but the money value of these losses is apparently so much less than the interest on the increased capitalization required to change all the machinery of a station from single to two or three phase types, that central station men would do well to look into the commercial advantages of this method.

Central Station Men and the C. E. A.

A LETTER was printed in the January issue which seemed to indicate a feeling on the part of some central station owners and managers that concerted action on the part of the operating branch of the electrical industry is becoming more necessary as electric lighting and power is becoming more general. The desirability of union and co-operation has been endorsed in the United States, where there is a National Electric Light Association and many independent local associations organized for the same purpose. In Great Britain questions relating to the methods of operation of central stations are discussed at meetings of municipal engineers' societies, gas engineering societies, and wherever there are found sufficient engineers interested in electricity, to give their

views or experience. On the continent of Europe, central station engineering is recognized as being a special branch of electrical study, and the central stations band together in order to promote their mutual interests, to further their knowledge of operating economies, and to guard themselves as an industry against the encroachments of the public on one hand and the manufacturing companies on the other. This spirit of co-operation has even taken the form in Germany of committees appointed by the central stations to investigate and examine into very many matters affecting the interests of the industry, and in which the experience of the individual is valuable as contributing to a sum total of conclusions which could only be formulated after such an exhaustive enquiry. Their latest committee, for example, has performed a most important service to the general body within the last few weeks, by making a most minute examination of the conditions of the incandescent lamp service and supply, making enquiries in every direction and bringing forward many points hitherto but little understood, and which have most important influence in operating expenses. The advantages to be gained by the co-operating of central station men will be perfectly evident when it is considered that they are required to supply to the public one of their greatest necessities—light; that they have to do this in competition with gas companies and also against that of the oil wells; that they are no longer able to get fancy prices for electricity, and that their dividends depend on their economical operation. They will be still more evident when it is considered, that this economical operation involves the study of problems connected with steam machinery as well as electric machinery and all sorts of electrical appliances. If it requires special training to qualify a steam engineer, and different special training to qualify an "electrician"; how much more special must be the training of the man who has to manage an electric light and power business in which both classes of machinery are used? The manager of every central station, large or small, has acquired experience with lamps, coal, carbons, rates, and what not, and such experience collected and published would be of great service to many other managers, who, having given their attention to other and equally important questions, would be able to reciprocate to the general benefit of the entire industry. We all want to know how our neighbour is getting on with some particular class of apparatus, and very likely will be able to give him some little valuable pointer in return for his suggestion, but at present every individual plant has to gain its experience for itself, often to buy it dear, whereas a little cordial co-operation would enable everyone to profit by the experience gained by some other one. A central station must indeed be in a position of ideal perfection if it can learn nothing at all from some other one. The Canadian Electrical Association is a body formed for the express purpose of facilitating this interchange of ideas and experiences. At the annual meetings many valuable papers are presented dealing with matters that come under the daily notice of central station men. It is this want of any organization in the electrical industry that is a principal cause of the crudeness of central station practice alluded to in our last issue. It is not too much to say that everybody loses by the present incoherence in the electric lighting profession. The public loses because the central station owners do not know the latest and best methods of supply nor keep themselves abreast of the times; the central station men lose greatly because each one buys his experience for himself, and since he is not able to compare his results with those attained elsewhere is most likely to fall into a groove. The manufacturing companies lose because they have more difficulty in introducing any new and more efficient machinery when they have to deal with each customer separately, than they would if they could present their new goods to an association, each member of which would be able to keep in touch with the others. But the central station man loses most of all, because every improvement in machinery, or in the method of its operation, tends to reduce costs of operation, and hence to increase profits.

CENTRAL STATION BOOK-KEEPING.

By GEO. WHITE-FRASER, E. E.
II.

HAVING generated our steam, we have to use it to the best advantage, and so must know something about the engine, how it works, whether it requires attention to valves, and so on. Steam has an expansive force as well as a direct pressure, and the greatest economy is attained when we make use of both in their proper proportions. If we admit steam to the cylinder, and allow it to act with full boiler pressure during the whole length of stroke, when we open the exhaust port this high-pressure steam will be allowed to go free without our having got nearly as much out of it as it is capable of. But if we admit steam during only a certain portion of the stroke, and then shut it off from boiler pressure, letting it expand itself down to a gradually lower and lower pressure, so that at the opening of the exhaust port it has no expansion force left—then we make use of all the power it can give us, and we use it economically. What is the good of letting steam go free into the atmosphere when it has force left in it still? What is the good of raising it to 100 lbs. pressure in the boiler, if we let it out of the cylinder when it still has 10 lbs. pressure left? We might just as well raise it to 90 lbs. in the boiler, and exhaust it at no pressure, or atmospheric pressure; only in this case we lower the power of the engine. The last thing to do is to so arrange that steam shall be admitted at boiler pressure in such quantity that when the exhaust opens it shall have expanded down to about no pressure. Then we shall have got all the good out of it it is capable of, and shall be using it economically. As a rule, engines are so proportioned and rated, that steam is admitted at boiler pressure for one-quarter of the stroke, and allowed to expand down during the other three-quarters, and that when this proportion is observed, it will be exhausted at just sufficiently above atmospheric pressure to ensure its freeing itself quickly.

It is understood that in the above I do not consider throttle valve engines, but only those that regulate power, and consequently speed, by means of cut-off valves. These engines are so made that they will automatically vary their own steam consumptions, in accordance with the work that they are required to do, by admitting steam for a longer or shorter period during each stroke; and an engine that has a rating of 100 h.p. at one-quarter cut-off will actually do much more when it allows half cut-off, or much less when it shuts off at only one-eighth of stroke, and these variations it can make itself, as it is running. It must, however, be clearly understood, that if this engine has such a large load placed on it as requires steam to be admitted at boiler pressure during half of a stroke, this steam will be exhausted into the air before it has nearly exhausted its expansion force, and so will be used wastefully. Or again, if a 100 h.p. quarter cut-off engine is run at so small a load as requires steam to be admitted during only one-eighth of stroke to keep the speed down to its proper number of revolutions, then this steam will have expanded down to atmospheric pressure some little time before the exhaust port opens, and as the piston still moves forward, there will be a partial vacuum formed where there actually should be a pressure, which is again a most extravagant and undesirable condition. The valves that open and shut the admission and exhaust ports are of course all movable, and are actuated by eccentrics or cams, or what not, that are also movable; which eccentrics are in turn thrown and their actions regulated by some form of governor, which is again in constant motion.

Now, I think that a general statement may be made that no one will feel disposed to contradict, viz: No piece of machinery that ever was made, simple or complex, is so perfect that it cannot get out of order or adjustment. This is especially true of a steam engine. The valves will most certainly wear out in time and leak; they may slip; the eccentric on its strap may work loose; the rod lengthen the sixteenth of an inch through a nut slackening; or the governor stick, or slip, or do some other vexatious thing that none would expect of it. Who can say what an engine is or is not capable of doing, when it is held together with nuts and bolts, and built of material that must wear? And any little thing it does wrong means extra expense and less profit.

Now consider for a moment what the consequences of a very little slip or stick in a valve may be. An exhaust valve may open a shade too soon or too late. In the former case steam will be exhausted before it has expanded down enough; in the latter it will not have time to get quite away, and some will be imprisoned in the cylinder to produce a back pressure. In the former case steam is wasted, in the latter a little more steam will be required to overcome the back pressure than would otherwise be necessary. In either case money is being wasted in fuel. Now, if oil is allowed to cake

with a little dust around the release of the exhaust valve, it may cause it to stick, and every person familiar with machinery knows how it can get out of order in the most inexplicable fashion. All these considerations serve to emphasize the necessity of keeping some track of the engine's working, and we have a means, in the indicator, of employing a private detective who will report to us with unfailing accuracy, everything that engine does. Is the cylinder or piston wearing? Are the rings getting loose? Is the admission valve getting the worse for usage? The indicator card gives indications of the steam blowing through. Are any of the valves opening or shutting too soon or too late? There it is on the accusing little diagram. Is anything wrong at all? The little indicator will run the offender to earth. Therefore it is, I say, do not trust your engine too much. Keep a watch on it, and record its operation frequently. Everyone has not got an indicator, but I think I should like to take cards once every week, and in order that the information may be complete, it would be necessary to record, at the instant of taking the card, the boiler pressure, the reading of the ammeter and the volt-meter of the dynamo or dynamos run by the engine, with the speed of engine, these in order that the load on the engine may be calculated, to compare with the indicator diagram. Cards should be taken at intervals throughout the run, when the load is at different points, so as to know what the engine does at all proportions of load.

The load on the engine for any card can be calculated by multiplying the ammeter and volt-meter readings together for wattage, and adding in the shafting and dynamo frictions, taking also into consideration the proportionate inefficiencies of dynamos at various loads, which can be obtained with more or less accuracy from the manufacturers.

The method of calculation of the real load on the engine corresponding to any observed ammeter and voltmeter readings, will be as follows, which will be quite close enough for all practical purposes:

Assuming a dynamo with the following manufacturing company's data and rating:

Capacity, 50 k.w.; commercial efficiency at full load, 95%; at half load, 90%; at one-quarter load, 85%. Full load current, 50 amperes; voltage, 1,000, and (for the sake of simplicity) no over-compounding, and allowing for no drop.

Then this machine will require to run it at full load

$$\frac{100 \times 50}{95} \text{ kilowatts or } \frac{100 \times 50}{95 \times 746} \text{ horse-power;}$$

$$\text{at half-load } \frac{100 \times 25}{90} \text{ kilowatts or } \frac{100 \times 25}{90 \times 746} \text{ horse-power;}$$

$$\text{at quarter-load } \frac{100 \times 12\frac{1}{2}}{85} \text{ kilowatts or } \frac{100 \times 12\frac{1}{2}}{85 \times 746} \text{ horse-power.}$$

Next an allowance must be made for the power wasted by the belt, which will depend in amount on the state the belt is kept in, but which, if that state is good, may be taken at say 8%, and an allowance for the shafting of say 10%. These amounts added together will show what the engine had to do when the card was taken, and a neat number of such cards can be averaged. The results can be collected and set forth in the form shown below, and the cards themselves should be very carefully studied by an experienced person, and the horse-power indicated by them recorded, with any remarks tending to explain their meaning.

Engine Number.....					Date.....		
Card Number	Ammeter	Volts	Total Watts	Total h.p. Electric	Belt	Shaft	Total Load
	Dy. 1	Dy. 2	Dy. 1	Dy. 2			

If it be impossible for any station to take cards so frequently, then they should by all means manage to have it done not less than every three months.

Before leaving this part of the station, there is one set of experiments and records that should be kept by everyone using a condensing plant, viz: records at fixed times during the run, of-reading of vacuum gauge and temperatures of condensing water, and water of condensation. If the condensed steam is to be used and fed back into the boiler, it is of advantage that it should be discharged from the condenser at as high a temperature as possible. But the less heat that is taken out of the exhaust steam, the lower will be the vacuum; consequently there will be found a point where increased temperature of water of condensation, far from being an economy, will actually be a disadvantage, and the most truly economical balance must be arrived at by experiment and calculation, and then preserved by constant care and attention.

We have now obtained a method of recording our steam genera-

tion and utilization, which will, I think, give the average central station a very fair insight into this important department, and I would suggest that every steam-using plant should experiment with different kinds of coal; mix different kinds together till, by comparing results, they arrive at what seems to be best for them. Then try to raise the temperature of their feed and so on, and whatever they do, keep moving and observing and learning. There is a link between the engine and dynamo which requires some attention—the belts. There is always some slip to a belt. It may be minimized, but some will always be there, and the amount of slip will to a great extent depend on the condition of the belt. I am of course assuming that it has been bought of sufficient size and strength. Now, this slip can be observed in the following way: Everyone knows that if an engine and a shaft are connected together by a belt, the speeds of their two pulleys will be in the inverse ratio of their diameters. That is the theory. Now, if an actual test be made of the speeds of an engine and of a shaft, by trying them at the same time, with hand speed counters, any difference between the calculated speed of the shaft and the observed speed can be set down to the slipping of the belt. Slipping means that the power of the engine is not being fully utilized, and therefore the belt should be made to grip tighter, either by tightening it up to its proper limit, or if that limit has been reached, by dressing it more thoroughly. This record of observed speed may or may not be set down in the reports—but I should certainly recommend the observation to be made at frequent intervals. The more checks you have on the operation of your machinery and apparatus, the better are your results likely to be.

We pass now to the records concerning the electric plant, merely mentioning that as the one engineer generally looks after the engine and dynamos, etc., the reports from the engine room may include the dynamo records as well as the consumption of waste, oil, sandpaper, etc., notice of which will be taken in the general summary. Among the dynamo records which I consider to be really necessary to an intelligent management is certainly one that I do not believe a single one of my readers will keep—for the reason that either they will think it too much trouble, or, alternately, if they think of getting a machine to do it for them, they will consider it too much expense. I allude to some record that will enable them to see how much electricity has been manufactured by the dynamo, and delivered to the lines each night. There are only two ways of doing this, either to use a recording station wattmeter, which will keep track of every watt of electric energy sent out, and which will cost in the neighborhood of \$100, or to make the engineer put down on paper at intervals of fifteen minutes or so the exact readings of the current and pressure indicators from which the station output can be closely calculated.

I think the absolute importance of some such record (preferably the wattmeter) will be evident to anyone if they will consider for a moment what its absence means. It simply means that a central station does not, and cannot know whether it is selling its electricity for more or less than its costs to make it. A farmer knows how much seed he puts into his field, and he measures the number of bushels he reaps from it; the merchant not only keeps account of the goods he buys to stock up with, but he knows how much has been sold each day, and if his stock-taking shows a difference between what he bought and what he has sold, he begins to look about and see whether he hasn't lost any or been robbed of some; in fact, if he didn't keep track of what went out of his store, as well as what came into it, he really wouldn't know what he was doing, whether he was solvent or bankrupt. A central station is in the same position, and if no record is kept of how much electricity goes out, what is the good of keeping track of how much comes in—in the shape of fuel?

It was observed above that there is a very clearly defined relation between the amount of coal burned and the amount of water turned into steam; and that if there is observed (as the result of records) a disparity between that amount of water actually evaporated, and the amount that theory indicates should be evaporated, that the matter should be looked into with a view of securing better results. The inference is drawn that if no records are kept, it is impossible to detect anything wrong, and consequently a great deal of waste may go on with no one knowing anything about it. Now this is exactly the same with regard to the electric plant. Mechanical energy has its equivalent in electrical energy.

If a force of one hundred mechanical horse power be continuously applied in turning a dynamo whose commercial efficiency is 90 per cent., then that dynamo should give out continuously electrical energy to the amount of 90 h. p. If it is observed that this

dynamo does not give out this electrical energy, then there is something wrong, some waste taking place, which should at once be remedied—if money is valuable. Now, it is known how much mechanical energy is expended during a run (the coal and evaporation records will give this), and therefore it can be easily calculated how much electricity should have been generated. But if it is not known how much actually has been generated, what is the good of all the other records?

Passing over the intermediate steps—so much coal should produce so much electricity. Does it? If not, why not? There may be something tremendously wrong somewhere in the plant, and it cannot be known without this nightly "stock-taking." How much does your current cost you to make? You cannot tell unless you know how much you make.

For the above reasons I strongly recommend the use of station wattmeters, and that they be read every night at the close of a run. A meter will cost about \$100; the interest on this for a year is about 85; and if it isn't worth that much to you in giving you an insight into your business, and enabling you to stop wastes, then there is no advantage in book-keeping.

Other useful records are: The engineer should note the reading of the current indicator every fifteen minutes during the early part of the run, and every half hour later, and construct a "load diagram" for every night. A comparison of these diagrams, week by week and month by month, is often of the greatest value, as indicating possible changes in the business policy of the central station, whereby better results may be attained. He should note every night whether there is a "ground" on the lines, and on which line, so that it may be hunted out and put right next day; and note any unusual happenings—lightning stroke passing through arresters; fuses suddenly blowing, with their cause (if known); new brushes put on dynamo, or anything else of that nature; commutator turned down, and so on.

Below are suggested forms that will be found convenient. Next article will be devoted to the part of the business outside the station, consisting of lines, lamps, etc., with some suggestions as to the store room.

Engine report by S. Smith.					Date.....
Engine No.	Started	Stopped	Vacuum Average.	Temperature Hotwell	Remarks as to Repairs, Accidents, &c.

It will perhaps be noticed, that what has gone before constitutes less a mere formulation of accounting systems than it does an enumeration of the inherent inefficiencies of all machinery, with some little indication of how their unchecked operation may affect

Dynamo report by					Date.....
Dyn. No.	Started	Stopped	Watt Meter, Start Stop.	Grounds?	Remarks as to Repairs, &c.

the financial results, and the description of a series of observations which will enable the intelligent manager to detect their undue extension, and hence to apply the appropriate remedies in time. The intention has been to show what very many sources of waste there are in the operation of a steam and electric plant, and that although a central station manager may buy the very best machinery in the world, it will do him not the least good unless he operates it properly. To use very high-class machinery, and to hire cheap labor, is to save at the spigot and waste at the bung hole.

(To be Continued.)

The Toronto Electric Light Company are installing a 75 kilowatt monocyelic generator of the Canadian General Electric Company's make.

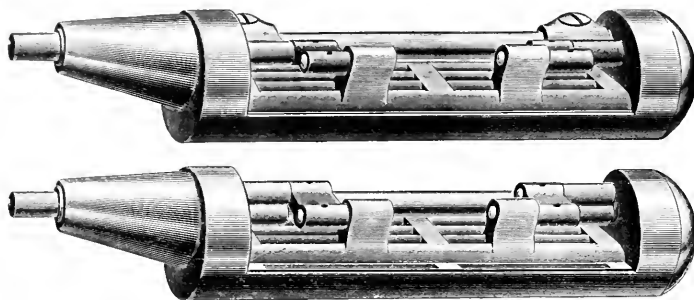
The new power house of the Oshawa Electric Railway Company has been completed. It is entirely of brick, and is equipped with Babcock & Wilcox boilers and two 150 h.p. cross-compound Robb-Armstrong engines, connected with a 200 k.w. six-pole Westinghouse generator. The installation was made by Ahern & Soper, of Ottawa, and makes a model power-house.

The Toronto Electric Light Company have closed a contract with the Canadian General Electric Co. for a 600 horse-power slow-speed direct-connected power generator. This machine will be the largest in Canada so far installed for the supply of current for stationary motors.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Hull, Que., asks: "Can a direct current of electricity be alternated into a transformer so that it will act on same like a current from an alternating machine? I mean a machine to change the direction of the direct current into the transformer; above machine, or a reserver, to be run by a belt."

ANSWER. Your question is asked in two parts: First, a direct current cannot be so acted upon by any transforming device as to change its pressure into one higher or lower, as is done with the alternating current.



VALVES OF WHEELLOCK ENGINE.

Second, the nature of a direct current can be so altered by an appropriate device, that this altered current may be passed through a transformer, with the familiar result. This is actually done in several electro-medical appliances, and in the familiar electric machine often seen at fairs and exhibitions, where an "electric shock" is administered for 5 cents. In this machine the direct current generated by an ordinary battery is sent through the primary of a Ruhmcorff coil (which is nothing more or less than a transformer), and while it is flowing it sets in automatic action a vibrating tongue, which actually forms part of the circuit; this tongue, in vibrating, opens and closes with extreme rapidity the primary circuit; and thus produces the rapidly varying induction in that primary circuit which is the necessary condition before it can affect the secondary circuit. There is no machine for effecting this rapid reversal of current, through the intervention of a belt; it could, undoubtedly, be done by passing a direct current through some form of commutator, which would pick it up from opposite brushes alternately; but the utility of this method is very much open to question. This commutator could be operated by a belt."

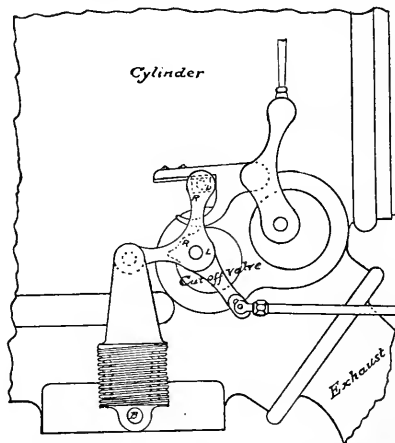
"W. B. S.," Montreal, asks: "Can any of your readers tell the writer if there is any book of tables in vogue, stating the number of amperes a wire will carry with a certain amount of heat, and how much increase in heat for each additional say to amperes. For example, say the temperature of the work room be 65° and a wire, No. 16, be raised 5 over this, with 10 amperes passing through, how much more will it be raised with 20 amperes passing through it? Will it be directly proportional? What is the safe limit to allow German silver or iron wire to heat up to in a resistance box, say such as a field shunt? i.e., what gauge, No. of amperes, assuming box to be freely ventilated, and wire simply in spirals?"

ANSWER.—We do not at this moment know of any book of tables giving the temperature or efficiencies of wires heated by the passage of a current. Messrs. Houston & Kennelly, of Philadelphia, have conducted

careful experiments to determine them, and, no doubt, are compiling a book of such data. Knowing the specific heating effect, the effect with any particular current on any known size of wire is easily calculated by the well-known $C^2 R$ rule. Your example can be worked out in the same way—thus twenty amperes will produce four times as much heat as ten amperes will, on the same wire. With wires of different sizes, and different lengths, the calculation is equally simple with the aid of a table giving the specific resistance or the circular milage of wires, and knowing previously the heating effect on one sample piece. Thus it is seen that the heating effect is not directly proportional to the increase in current, but it is proportional to the square of the current increase or decrease, and directly proportional to the resistances. The safe limit of heat for rheostat wires is a matter that depends on ventilation, as much as anything else. A current that would heat a wire to a red heat in a confined space will be perfectly safe when cool

air circulates around it freely. Knowing the current that the rheostat will want to shunt (maximum), it will be safe to allow about one square inch of radiating (cooling) surface of rheostat for every ten watts absorbed by it."

"J. B.," writes from a Western Ontario town, as follows: "I am in charge of a Wheelock engine, but have never seen the valves of this engine nor even a cut of the valves. I have seen instructions in mechanical papers for setting valves of other engines, but never a Wheelock. Could you tell me where I could get the information I want?"



VALVE OF WHEELLOCK ENGINE—SHOWING VALVE MOTION AT END OF CYLINDER.

ANSWER.—The accompanying cuts and diagram, for which we are indebted to the Goldie & McCulloch Co., of Galt, Ont., the Canadian manufacturers of the Wheelock engine, will doubtless enable our correspondent to understand the valve mechanism. The diagram shows the dashpot and a portion of the valve motion for one end of cylinder. On the arm of cut-off valve will be noticed the letters R and L. When the valve is at rest and the hook detached, the line R should be

perfectly perpendicular; the dashpot will be down and the spring closed. Should the line not be perpendicular, the stud B has an eccentric pin on the end and the dashpot can be raised or lowered by loosening the set screw and turning stud. Sometimes this is necessary owing to the leather under dashpot getting worn thin. With the crank of engine on dead centre and the hook attached so as to hold the cut-off valve open, the line L will be perfectly perpendicular. With this correct, the engine will have the proper lead, for the line L shews the lead line. If this is not correct, it can be changed by moving the eccentric on shaft. After taking a diagram, should the engineer find more load on one end of cylinder than the other, all that is necessary to do is to shorten or lengthen the rod between the two trips, as the case may require, it having a right-hand thread at one end and a left-hand thread at the other; one of the trips is shown on diagram at C. The rod shown on diagram is not the rod referred to, but extends back from the trip C to the valve at back end of cylinder, the diagram being taken from front or frame end of cylinder. The rod shown is from the valve motion to the governor and this should not be changed by the engineer, as it is always set before leaving the shop; in fact, none of the rods should be changed except the one mentioned between the two trips. The valves are always carefully set before the engine is shipped, but the points mentioned may become necessary by the valve motion getting worn. No changes should be made unless the person making them is thoroughly conversant with all parts of the engine.

"A CONSTANT READER," Whitby, Ont., writes: "Please answer me the following questions in your next issue of the ELECTRICAL NEWS: 'Describe a pump, an injector, a boiler, a steam engine; also how it is, when lamps are connected in series, as in railway circuits, the highest voltage lamp always gives the brightest light?'"

ANSWER.—Proper and thoroughly comprehensive answers to your questions would involve writing a treatise on steam machinery which would somewhat exceed the limits of one of our ordinary issues—but, assuming that you have at least an elementary knowledge of physical and mechanical principles—the following answers may satisfy. (a) A pump (assuming it to be a water pump) is an apparatus for attaining two objects, viz.: Either for raising water from a lower to a higher level against the force of gravity; or for forcing water into some receptacle against some counteracting force. (b) An injector is an apparatus for forcing water into a receptacle against a counteracting force. It is used in connection with a steam plant to force feed water into the boiler against the pressure of steam in that boiler. In so far, it serves the same purpose as a "feed pump," but its method of doing so is different. (c) A boiler is an apparatus in which is made the steam required for use in a steam engine. It is so constructed that the steam raised from the heated water is not permitted to escape in the atmosphere but is imprisoned within it until required for use. (d) A steam engine is a device for enabling man to avail himself of the enormous power of steam under pressure. The above definitions are all that can be given in such a short space. If they be not sufficient then there is an immense technical literature on the subject, which will probably give a better idea as to why. When lamps are

connected in series, the highest voltage lamp always gives the brightest light. It is a phenomenon we have not observed ourselves, and, therefore, cannot say. There is probably some difference in the lamps themselves. We should like to hear a little more about it.

SPARKS.

The Ottawa Electric Railway have adopted the fare box system of collecting fares.

The project to build an electric railway from Vancouver to Port Langley, B. C., is again being revived.

The Canadian General Electric Co. have been granted a franchise for electric lighting at Tavistock, Ont.

Messrs. W. H. and E. C. Breithaupt have purchased a controlling interest in the Berlin and Waterloo electric street railway.

In the city of Ottawa there are 13.14 miles of electric railway, composed of 3.04 miles of single and 0.78 miles of double track.

Mr. T. Vian, the promoter of the electric railway between Hull and Aylmer, Que., has disposed of his franchise to an Ottawa syndicate.

The Crystal Beach Improvement Co., of Ridgeway, Ont., propose constructing two miles of electric railway, extending from Crystal Beach to Ridgeway.

A company is being formed at Hamilton, Ont., to open a summer resort at Chedoke Park, and to build a double track electric railway along Herkimer and Queen streets.

The car stables of the Oshawa Electric Railway Co. were recently destroyed by fire. In the sheds were two open summer cars and one winter car, which were also burned. The loss to the company is placed at \$10,000.

Incorporation will be asked at the next session of the Ontario Legislature for the Manitoulin & Pacific Railway Co., with power to construct a steam or electric railway across Manitoulin Island. The solicitors for the company are Messrs. Clark, Bowes, Hilton & Swabey, of Toronto.

Messrs. H. A. Beatty and J. W. Horn, of Toronto, representing a syndicate of capitalists, propose to construct an electric railway in the town of Chatham, Ont. The prospects are that a railway will be constructed embracing the principal towns and townships within a radius of thirty miles.

The ratepayers of the village of Lanark will vote on a by-law to bonus the Lanark County Electric Railway to the extent of \$10,000, to build a road from Perth to Lanark. The members of the company are J. B. Reilly, Alex Wender, Thos. Henry, A. H. Edwards and James Fowler.

The Hamilton Radial Electric Railway Company will make application to the Ontario Legislature for an act extending the time for the completion of their road, and authorizing the extension of one of their branches from Mimico to the city of Toronto, and another from Brantford to Woodstock.

The contract for the construction of an electric railway for the town of Cornwall, Ont., has been awarded to Messrs. Hooper, of New York, and Starr, of Montreal. The contractors expect to have the road completed by the 1st of June. The franchise was held by Mr. W. R. Hitchcock, electrician, of Cornwall.

Negotiations for electrifying the St. Thomas street railway are said to have been abandoned. The reason assigned is that owing to delay the company was unable to secure the financial assistance expected, and cannot proceed unless the city guarantees its bonds. An offer to sell the franchise at a low figure is now made.

The trustees of the Manitoba Electric and Gas Light Co., having made default in calling a meeting of debenture holders after the necessary notice had been given, certain holders, representing one-fifth in value of the debentures have given notice that a meeting will be held at the office of R. A. McLean & Co., London, Eng., on the 28th inst., to consider the appointment, if considered advisable, of a successor to Mr. Duncan McArthur, one of the trustees.

We have received a copy of a special souvenir number of the Providence, R. I., "Telegram" containing, among other features of interest, a series of illustrations showing the growth of the Eugene F. Phillips Electrical Works, together with portraits of the founder and present officers of the company. There is an illustration also of the branch works in Montreal, but we were disappointed at not seeing the portrait of the enterprising manager of this branch Mr. John Carroll.

BY THE WAY.

Mr. John Langton, the well-known electrical consulting engineer, of Toronto, has recently been acting in that capacity in connection with several electrical enterprises in the United States, and is considering the question of opening a branch office in New York city. I took advantage of the opportunity afforded by his recent visit to Toronto to submit to him a few questions regarding the directions in which the greatest development is taking place and is likely to take place in the applications of electricity. Seeing that a commencement has been made in Canada in the direction of transmission of electricity for power over considerable distances, I enquired what, in his opinion, would be the future developments along this line. His reply was, that he believed there would be a considerable development in power transmission schemes over distances of from 5 to 15 miles, a less number over distances of from 15 to 25 miles, and very few over longer distances than 25 miles. He does not anticipate as great development in the direction of the application of electricity to railway purposes, as many persons look for. One of the most promising fields he believes to be in the manufacturing world, in connection with the increased use of electric motors and a greater number of private lighting plants. Turning to the subject of the cost of electric light and power, Mr. Langton stated that prices are very much lower in Canada than in the United States; indeed he found, by comparison, that an estimate given him recently for a constant supply of current for power purposes in New York, was almost exactly double the price given him in Toronto for an intermittent service. Of course the value of real estate and the consequent expensiveness of doing business in New York city accounts to some extent, for this difference in price; but allowing for this, the fact remains that prices in the United States are not cut to nearly so fine a point as in Canada, and it is difficult to see any reason for the unprofitable rates which prevail in this country. As to the result of the introduction of acetylene gas, Mr. Langton has been informed by a gentleman, said to be well qualified to speak with authority on the subject, that acetylene gas has for some time been manufactured and used in Switzerland, without regard apparently to the exclusive patent rights to which Mr. T. L. Wilson, the alleged inventor, lays claim. The surprising thing is, if this gentleman's statement be correct, that Mr. Wilson should have succeeded in obtaining from the gas companies of the United States such large amounts in cash for territorial rights to the use of his discovery.

x x x x

A CORRESPONDENT of the Hardware Merchant reports the following interview at Dunnville, Ont., which goes to show that even bright lights of the church are sometimes not above attempting to shine in "borrowed" light at the expense of the electric light company:—"Where's the boss?" I asked as I strolled into J. H. Rowe's store, Dunnville. "Up at the Baptist church," was the reply. And feeling that as the mountain was unlikely to come to Mahomet, Mahomet would have to repair to the mountain, I wended my way to church (?) After greeting me, and in reply to my query, "What are you doing?" he said: "I think I am one too many for the Electric Light Co. I am interested considerably in church work, and, wanting to light up the basement of our church with the incandescent light, I asked the company if they would make any reduction in price

charged for arc light in church. Being answered in the negative, I racked my brain for a scheme to get ahead of them, and finally struck upon the plan of making a hole through the floor. And on Wednesday and Friday nights the arc light above can be lowered into the basement, and now we will get three nights' light for 50c. per week instead of one."

x x x x

In the pioneer days of telegraphy in Canada an Irishman, whose son had gone to the North-west, wanted to send his boy a pair of new boots, and conceived the idea that the quickest method of delivery he could adopt would be the telegraph. Somebody had told him that communications could be sent very quickly that way, and he didn't see why a pair of new boots shouldn't go in the same manner. He wasn't quite sure how to go about it but concluded that the proper way would be to hang the boots on the wire, which he did. Soon after, a tramp passing the spot, caught sight of the boots slung across the wire, climbed the pole and appropriated them, hanging up his old ones in their place. By and bye the Irishman returned, and seeing the old boots, exclaimed: "Bedad, Jimmy's sint back his old boots t'let me know he got the new wuns."

x x x x

Mr. John Carroll, the well-known representative of the Eugene F. Phillips Electrical Works, Montreal, is repeating with much relish a story of which he was recently made the recipient at Lancaster, Ont. A farmer living on the outskirts of that town was recently boasting to his urban neighbors that his house was entirely lighted with electricity. The announcement was received with incredulity by the townspeople, who wouldn't believe that the agricultural population had so suddenly decided to put on airs and add to their expense account. They finally decided to accept the farmer's invitation to visit his house and see for themselves. On their arrival at the farm house this is what they saw: a single incandescent lamp suspended from the ceiling of the dining room, with sufficient cord attached to enable the farmer and his family to transport the light to any part of the premises. The difference in cost between an incandescent lamp and a lantern, is all the farmer's progressiveness cost him, and this, no doubt, is offset by a reduction in his insurance premium consequent upon the lessened fire hazard.

SPARKS.

The Leamington Electric Light Co. are installing a 60 kilowatt Canadian General single-phase alternator.

The number of passengers carried over the Galt, Preston and Hespeler Street Railway in 1895 was 175,000.

Mr. Beemer, the promoter of the electric railway at Quebec, is said to have made the necessary arrangements for carrying out the work.

The Montreal Street Railway Company recently placed an increase order for 40 C.G.E. 800 and 20 C.G.E. 1,200 railway motors with the Canadian General Electric Company.

Mr. Isaac McKay, of St. Thomas, who was engineer of construction of the London electric railway, has accepted an offer to superintend the construction of a new street railway in Cleveland.

The electric light plant at Alexandria, Ont., is now in operation. The power house, situated about two miles from Alexandria, is a substantial stone building, and is equipped with a 60 K. W. 2,000 volt alternator, driven by a Robb-Armstrong engine. The switchboard is of marble, and the whole plant is a very substantial and practical piece of work, and reflects credit upon the contractors, Messrs. Ahearn & Soper, Ottawa.

WAFFER TUBE BOILERS.*

By W. T. BONSER.

WHEN your worthy secretary called upon me for a paper on water tube boilers, I little realized the difficulty attending the work, for the subject has already been so fully and so ably discussed in the technical journals, and even in the ordinary trade catalogues, that I fear my humble contribution to the proceedings of this Society will contain little that is new or interesting. However, hoping that I may at least be fortunate enough to glean from fields which possibly some of you have passed over, I beg your indulgence and attention to certain facts, which we of the water tube persuasion believe to be proof positive of the correctness of our system.

OLD AND NEW.

Not at all infrequently are the promoters of water tube boilers called upon to furnish evidence of the extent to which such boilers are, and have been used. The prevailing idea in the minds of many steam users appears to be that of mistrust in the principle and effect of water tube boilers. It is not what their fathers used, neither does their local boiler maker approve of them, a negative premise naturally calling for a negative conclusion.

Why are not water tube boilers in more general use? Because, as was explained in a discussion of the subject by the American Society of Mechanical Engineers, they require a high class of engineering to make them successful. The plain cylinder is an easy thing to make. It requires little skill to rivet sheets into a cylinder, build a fire under it, and call it a boiler; and because it is easy and anyone can make such a boiler, because it requires no special engineering, they have been made, and are still made, to a very large extent. The water tube boiler, on the other hand, requires much more skill in order to make it successful, a fact proven by the great number of failures in that line.

Water tube boilers are not new. From the earliest days there have been those who recognized their advantages, and in modern practice to refuse them equal consideration with the best known mechanical appliances of other types, is only pardonable on the ground of ignorance or injustice.

I was greatly amused recently to find in a so-called engineering journal, the following item of news:—

"At Davenport, Ia., the old battery of four boilers at the Arsenal is being replaced by two boilers of novel construction in that region. The new boilers are 200 h.p. each, and instead of the heat passing through tubes surrounded by water, as in the ordinary boiler, the process is reversed, and the water in pipes passes through a current of hot air, thus giving a greater heating surface and insuring the greatest safety."

Plainly these are nothing more or less than our ordinary water tube boilers, and it is quite evident that the author of that item gauges the progress of this world by the developments on the little rock island in the Mississippi, occupied by the United States Arsenal.

Contrast with this another item of news in the *Youths Companion*, to which my nine-year old boy called my attention only a few days ago. It read as follows:—

"An interesting discovery has recently been made in the Museum at Naples, where the works of art and utensils found in the buried city of Pompeii are preserved. Careful inspection of one of the ancient copper vase-shaped vessels there, has shown that it is in reality a tubular boiler. That this form of boiler should have been known to the Romans two thousand years ago is somewhat remarkable. For just what purpose it was used is not known, but the boiler is well-constructed and contains five tubes running across a central fire-box, and so arranged as to permit the water surrounding the fire-box to circulate through them in a continuous current. The soldering of the tubes was so skilfully done that it remains intact to-day, and the cover of the boiler closes hermetically. The entire height of the machine, which, as remarked above, is shaped like a vase with two side handles and three feet, is only about 17 inches. It has been suggested that it may have been employed for distilling purposes. However that may be, its preservation under the ashes of Vesuvius proves that tubular boilers are not altogether a product of modern invention."

No doubt you have all read Lord Lytton's account of the last days of Pompeii, and recall his description of the wonderful therme or baths, which formed so prominent a feature of every Roman city during the first century. Possibly this ancient boiler was designed by one of those bright Roman or Grecian mechanics

for heating the water for the Sudatorium or warm baths.

We find it duplicated almost exactly in the Galloway water tubes of the present day, and I have no doubt if we could follow up this investigation of ancient boilers, we would find the knowledge possessed by the ancient Greeks and Romans was not confined to Poetry, Sculpture and Art, but that even water tube boilers and heaters were known to them.

The principle of the Galloway tube originated at the time when probably the first steam boiler made in this world was constructed. It is not known when the first steam boiler was constructed, but the first steam boiler recorded was made about 200 years before

the year one of our era.

In a discussion of various forms of shell and water tube boilers at the New York meeting of the American Society of Mechanical Engineers in 1885, Mr. W. F. Durfee gives an illustration of this very unique boiler, copied from the first Latin translation of the *Pneumatics* of Hero of Alexandria, who lived and wrote about 200 B.C.

Its construction is shown in Figs. 216 and 217. The figure is copied from the Latin translation referred to, and represents a perspective elevation of the boiler and its appendages, showing its internal construction by dotted lines. The second figure (217) was drawn by Mr. Durfee to facilitate explanation; it shows a horizontal section of Fig. 216 taken just below the top.

The apparatus consists of a vertical cylindrical shell, whose ends

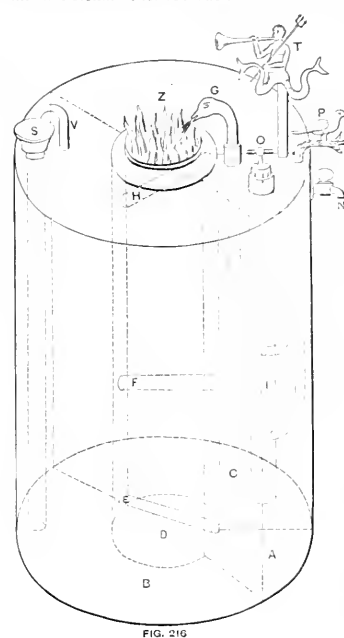


FIG. 216

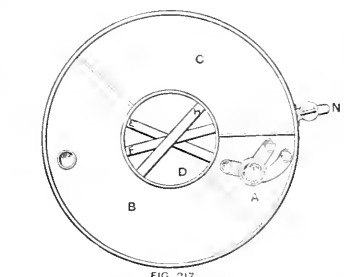


FIG. 217

are closed by heads, through the centre of which passes a vertical cylindrical flue, D, whose upper end is provided with grates for the support of the fire, Z, the hot gases from which passed downward through the flue. The space between the flue and shell is divided by diaphragms into three unequal compartments, A, B, C, in the first of which steam is generated, the others being simply reservoirs of hot water. The central flue, D, is crossed by three cylindrical tubes, H, F, E, the tubes, H, F, connecting the hot water spaces, B, C, act in the same way as the Galloway tubes, now in common use, but the bottom tube is closed at the end, E, its opposite end opening into the smallest or steam compartment, A. The compartment, B, is provided with a funnel, S, whose tube extends nearly to the bottom of the boiler; and also with a safety tube, V, whose curved upper end is immediately above the funnel, S. The compartment, C, has a cock, N, from which the water is drawn. The compartment, A, has within it a three-way cock, I, the three discharge pipes of which are connected with the goose-neck blow pipe, G, the triton, T, and the singing-bird, P, respectively. The three-way cock, I, is operated by a cross-handle, O, and the upper end of its plug has graduations which, when brought opposite an index mark on the shell

* Paper read before the Mining Association of Quebec.

of the cock, determine which of the three discharge pipes shall receive the steam generated in compartment A.

The principal function of this apparatus was to furnish hot water, and it is so contrived that it is impossible to draw any considerable amount of hot water from the cock N, without putting in an equal quantity of cold in the funnel S. In order to put this apparatus at work, the compartments B and C were filled with water to a level above the upper water tube H, by means of the funnel S. The goose-neck G was then removed and water poured into the compartment A, sufficient to fill it nearly to the lower end of the three-way cock I. The fire was then lighted, and as soon as steam manifested itself, the goose-neck G was returned to its socket and placed in such a position that the fire Z was blown by the issuing steam. The three-way cock I could be turned by its handle O, so that the steam would cause the triton T to sound his trumpet, or the bird P to warble, and thus announce to interested parties that the water was "boiling hot." In case any steam generated in the compartments B and C, it found an exit through the safety-pipe V, and any entrained water re-entered the boiler through the funnel S. In case it was desired to draw hot water in any great quantity from the cock N, it was necessary to supply an equal quantity of cold water through the funnel S, this requirement insuring a constant volume of water in the boiler.

But I need not weary you with ancient history. It may satisfy our curiosity and lend some additional color to Solomon's proverb that "There is nothing new under the sun," yet we cannot expect ancient Greece or Rome to furnish models for our boiler makers of to-day. Only by comparison do we really begin to appreciate the vast changes by which the engineering talent of to-day is taxed to its utmost to produce machinery and appliances which will accomplish the greatest amount of work for the longest period, with the least expenditure of effort. Steam boilers perhaps have not attained that degree of perfection usually accorded to the steam engine, yet when we note the progress which has really been made, and realize how close we have approached to the theoretically perfect boiler, we have great cause to feel encouraged.

Of the two hundred and sixty odd boilers recorded in Mr. Bell's most valuable Directory of Canadian Mining Industries, 30% or 5,400 h.p. are of the water tube type, and 50% or 9,000 h.p. are shell boilers, leaving 20% or 3,600 h.p. unclassified.

Since practically all of the above water tube boilers have been installed within the past ten years, we can safely infer that in the mining trade at least, more horse-power of water tube boilers are now sold each year, than all the other types combined.

There is no better evidence of the survival of the fittest in modern boiler practice, than a comparison of the various types exhibited at the Centennial Exhibition of 1876, with those shown at the World's Fair, 17 years later. At the Centennial there were exhibited 14 different types of boilers, of which two were cast-iron sectional, four were shell or tubular boilers, two were shell boilers with water tubes crossing internal fire tubes, while seven were exclusively water tube boilers. Of the whole number exhibited at the Centennial, but one, the Babcock & Wilcox, reappeared in its original form at the World's Fair in 1893. Of the fifty-two boilers exhibited in the main boiler room at the World's Fair, all were of the water tube type, while thirty-one of them were distinct copies of the original boiler patented by Stephen Wilcox in 1836, just forty years ago.

THE PERFECT BOILER.

What really constitutes a perfect boiler? Mr. George H. Babcock in his life-time undertook to formulate the twelve fundamental principles upon which it should be built. It was about twenty years ago that his formulas were first published, yet those same principles still live, and are looked upon to-day as the acme of scientific boiler construction. I need not repeat them here; they have long occupied a prominent page in the Babcock & Wilcox Co.'s book "Steam." But rarely do we find so much truth in so few words.

Few boilers there are entirely devoid of all good talking points, but do not be satisfied with a boiler simply because it is made of good materials and workmanship, or because it has a mud drum, or because it has large water and steam capacity, or because it has a large disengaging surface, or because it has a good circulation, or because it is built in sections and is therefore safe in the event of explosion, or because it is able to withstand high pressure and unequal expansion, and has its joints protected from the fire, or because the furnace is provided with chambers for the proper combustion of the gases, or because the heating surface is composed of thin metal so arranged that the hot gases will cross it at right angles, and only leave it when the greatest possible

heat is extracted from them, or because it will work up to or over its full rated capacity with the highest economy, or because it is fitted with the best quality gauges and fittings. Each of these qualities add greatly to the value of a steam boiler, but that one is best which combines the greatest number of such qualities, and therefore proves the best investment independent of first cost.

Messrs. Galloways, Ltd., of Manchester, Eng., illustrate on page 94 of their late catalogue, what they are pleased to designate as their "Manchester Boiler," but which is in reality a reproduction of the ordinary inclined water tube boiler, built by so many manufacturers of to-day. In explanation of this marked deviation from the Galloway, Lancashire, and Cornish boilers which they have been building for so many years, Messrs. Galloways, Ltd., say:—

"For ordinary pressures the Galloways boiler possesses great advantages, but beyond that, cylindrical boilers are frequently of large diameter, necessitating extremely heavy plates, and although for marine practice this is carried out, yet for situations where the conditions are less rigid, it is advisable to have a boiler more suited to the requirements of the case.

"In addition to this, where transport of large pieces is difficult, the Manchester boiler offers considerable advantages, as the largest piece is the upper vessel, which rarely exceeds five feet in diameter, twenty feet in length, and four tons in weight, the tube rods and boxes being separate. It will be seen that all the tubes are inserted into one water box or chamber at each end, the front one connected to the upper vessel by a wide neck, and the back chamber by a large circular connection, by which means an even circulation is kept up. The boiler is further provided with an internal arrangement in the upper vessel for separating the steam from the water, thus preventing priming and its attendant evils. This arrangement of boiler has been largely adopted on the Continent, and we anticipate that when its merits become known, it will be received with great favor by steam users requiring boilers for high pressure."

That is good; coming from such an eminent authority, we can only interpret their adoption of the water tube principle as a strong endorsement of the work accomplished by their predecessors in that field of engineering. I fully expect, however, in the next issue of their catalogue, Messrs. Galloways will have overcome their prejudices sufficiently to limit the diameter of their drums to 36" or 42", and that they will further arrange to enclose the drum so as to utilize its surface for heating rather than condensing. Then they may add to the merits of their boiler, safety and economy.

I might add that although Messrs. Galloways are pleased to limit the use of their water tube boilers to stationary work, the boilers of that type are just now making tremendous strides in the race for supremacy in marine practice.

As an example in proof of this statement I might refer to the steamers Turret Cape and Turret Crown, which have just closed a very successful season in the coal carrying trade between Sydney and Montreal. From their lessees the Dominion Coal Co., I learn that the two steamers have a combined record of 27 trips, extending over a period of 44 weeks, during which time they brought 66,981 tons of coal into this port. To this total should be added 11,700 tons for short cargoes, made necessary by the very low water in the river and canal, which difficulty prevailed through all of last season. Had there been a sufficient depth of water, both steamers could just have easily have brought in a full cargo each trip.

The actual carrying capacity of each of the Turret boats is 3,000 tons. They are fitted with water tube marine boilers, 2,200 square feet of heating surface being the total for each boat. They have been kept in continual service right through the season, and the captain's log shows a clean record for the boilers.

Many other and larger steamers fitted with water tube boilers have gone into commission during the past few months, and in every case the boilers have given the greatest satisfaction.

CAPACITY.

The term "Horse Power" is one which admits of a wide interpretation, being little understood by some and often misapplied by others. Originally used as a unit of capacity by James Watt, and supposed to be the average amount of work performed by a good strong English cart horse, its value is 33,000 lbs. raised one foot high per minute. It may be expressed in any equivalent of this unit as one pound, raised 33,000 feet high per minute. At best this is but an arbitrary unit, since the actual value of a horse-power depends, as a Yankee boiler maker has very aptly expressed it, upon the size of the horse. The evolution of the term "horse-power" as applied to steam boilers, has been gradual but not the less marked.

Prior to the advent of compound and triple-expansion engines, it was always customary to calculate the steam consumption of the ordinary slide valve engines then in most common use, at the rate of one cubic foot of water per hour, or say 62½ lbs. For instance, a 10 h.p. engine would require a boiler capable of evaporating 62½ lbs. of water per hour. In general practice it was found boilers of different types of construction varied in evaporative capacity according to the efficiency of their total heating surface, the amount required per h.p. averaging about as follows:—For plain cylinder boilers, 10 square feet; for large flue boilers, 12 square feet; for horizontal and multitubular boilers, 15 square feet.

Of late years tremendous strides have been made in the development of the steam engine, so that instead of one cubic foot of water, or 62½ lbs. steam consumption per h.p. per hour, the modern engine builder knows that he must develop a horse-power with less than 30 lbs. of steam for simple non-condensing engines, and from that down to 13 lbs. or less for triple expansion condensing engines, depending upon the size of plant and number of cylinder expansions.

Here then arises a serious complication in the determination of horse-power. Shall it be a large or a small horse? The prospective purchaser should consider this matter carefully, and demand that all tenders must state specifically the actual evaporative capacity of boilers to be purchased, to be determined if necessary by a practical test. The American Society of Mechanical Engineers has very properly solved this problem by the favorable consideration of its Special Committee's report at the New York meeting in 1885, whereby the equivalent evaporation of 30 lbs. of water from a temperature of 100° Fah. into steam at 70 lbs. pressure, is fixed as a boiler horse-power.

American manufacturers generally have adopted this standard, and while they may differ in the number of square feet of heating surface they allow for developing a horse-power, there is no longer any doubt as to the size of the horse.

I cannot leave the subject of horse-power capacity without first making a strong appeal for a more uniform rating of boilers, a rating which has some tangible basis. Not until you are able to compare boilers by the actual number of square feet of effective heating surface they contain, or the actual number of pounds of water they will evaporate under ordinary working conditions, can you judge whether one boiler is cheaper than another.

I confess I was greatly shocked only a few days ago, to hear the admission of a fire-tube boiler man, that he only figured the upper half of his tubes as effective heating surface. I shall always remember him as an honest man of good sense. There is no question but that fire tubes and shell plates exposed to the direct action of hot gases, form very efficient heating surfaces when they are clean, but who is there who will claim the possibility of keeping such surface constantly clean while the boiler is in active service.

Effective heating surface is that which receives the direct contact of the hot flame or gases and continues to do so without interruption from soot, or interference by close furnace walls, or baffle plates. This is the proper basis upon which to purchase your boiler, other conditions of course being equal.

SAFETY.

I have been asked why a water-tube boiler is necessarily a safety boiler. It is not necessarily a safety boiler; in fact I could name a number of water-tube boilers which are safe in name only. Certainly a boiler with very wide flat stayed surfaces, enclosing chambers receiving the combined circulation of all the tubes, should not be considered a safety boiler. Stay bolts and braces at best are a constant menace to safety, since they are usually located in inaccessible places, difficult to inspect and repair. But the principal objection appears to be the impossibility of providing braces which brace at the proper moment. How is it possible to assemble a number of pieces of metal, all of different sizes and shapes, and subject to greatly varying temperatures, and expect them to expand, contract, and remain uniformly tight at all times? But it is to be regretted that in defending the principle of water-tube boilers, there are other weaknesses to apologize for than braces and stays. There are those with tubes closed at one or both ends, the aggregation of pipe and fittings, and the bent tube monstrosities, so aptly described in a recent publication called "Facts," all more or less dangerous because they cannot be cleaned.

That a boiler can be made so as to be practically safe from explosion is a demonstrated fact, of which no one at all acquainted with modern engineering has any doubt. Of this class of boilers the Babcock & Wilcox is a pre-eminent example from the length

of time which it has been upon the market, and the large number which have been for years in use under all sorts of circumstances and conditions, and under all kinds of management, without a single instance of disastrous explosion.

The Babcock & Wilcox water-tube boiler has all the elements of safety, in connection with its other characteristics of economy, durability, accessibility, etc. Being composed of wrought iron tubes and a drum of comparatively small diameter, it has a great excess of strength over any pressure which it is desirable to use. As the rapid circulation of the water insures equal temperature in all parts, the strains due to unequal expansion cannot occur to deteriorate its strength. The construction of the boiler, moreover, is such that, should unequal expansion occur under extraordinary circumstances, no objectionable strain can be caused thereby, ample elasticity being provided for that purpose in the method of construction.

In this boiler, so powerful is the circulation, that as long as there is sufficient water to about half fill the tubes, a rapid current flows through the whole boiler, but if the tubes should finally get almost empty, the circulation then ceases, and the boiler might burn and give out. By that time, however, it is so nearly empty as to be incapable of harm if ruptured.

Its successful record of over twenty-five years proves that by the application of correct principles, the use of proper care and good material in construction, a boiler can be made so as to be in fact, as well as in name, a "safety boiler."

CANADIAN ELECTRICAL ASSOCIATION.

The Executive Committee of the above Association met in Toronto on the 16th of January to discuss preliminaries in connection with the arrangements for the convention which is to take place in that city in June next. Several sub-committees were appointed to further these arrangements, and report to the Executive at another meeting to be held shortly.

Subjects upon which it would be desirable to have papers were considered, and a selection made. An invitation has been extended to a number of qualified persons to furnish papers on these selected subjects, and from the majority the Secretary has already received favorable responses.

Judging by these favorable initiatory proceedings, and taking into consideration the fact that the convention is to be held in the Queen City of the West, in the locality of which a large proportion of the members of the Association reside, and at the most favorable season of the year, there is reason to anticipate that great success will crown the event.

In the interim before the convention, every person connected with or interested in the electrical interests of Canada, who is not already a member of the Canadian Electrical Association, should connect himself with the organization. This especially applies to persons connected with the electric lighting industry, for reasons which have recently been mentioned in these columns.

TRADE NOTES.

Attention is called to the advertisement of Messrs. Ahern & Soper, in another column, offering for sale second-hand machinery.

The Royal Electric Co. have just completed the installation of a 30 k.w. "S.K.C." two-phase generator, for the Glenwilliams Electric Light Co., at Georgetown, Ont.

The Ottawa Carbon Co. advise us that they are turning out 20,000 carbons per day, and have orders in hand at present sufficient to keep their works employed until May next.

The Packard Electric Co., of St. Catharines, Ont., have opened an electrical repair department in connection with their works. They are making a specialty of re-winding street railway armatures and transformers, and already have several orders on hand.

John W. Skinner, of Mitchell, Ont., advises us that he sold during the month of January, seven electric motors and two lighting plants. Mr. Skinner has had a large experience, having installed, perhaps, as many plants of different systems as any man in the business.

The Power Rope and Belting Co., of St. Catharines, Ont., has been incorporated, to manufacture belting by a new process, under patents granted to Mr. H. Ellis. The capital stock is \$20,000, and the promoters are: J. W. Coy, Harry Ellis, H. Flummerfelt, F. Coy, all of St. Catharines, and L. Raymond, of Welland.

Mr. G. A. Powell, assistant manager of the Packard Electric Co., St. Catharines, Ont., informs us that his Company were appointed in October last, Canadian agents for the Bryant Electric Co., of Bridgeport, Conn., manufacturers of electrical specialties, and the R. Thomas & Sons Co., of East Liverpool, Ohio, porcelain manufacturers

ELECTRIC RAILWAY DEPARTMENT.

BRANTFORD ELECTRIC RAILWAY.

This road is principally owned and operated by the Canadian General Electric Co., and has been in operation as an electric road since 31st of March, 1893. The officers are well-known financial railroad and electric men, viz.: Pres., Frederic Nicholls; Vice-Pres., H. P. Dwight; Sec'y.-Treas., W. S. Andrews; Board of



BRANTFORD ELECTRIC RAILWAY—MOHAWK PARK.

Directors, Robt. Jaffray, Hugh Ryan, Geo. A. Cox, W. R. Brock and Thos. Long. The road is under the management of Mr. Jas. T. Madden who has been in the railroad business for a number of years having held a responsible position with the C. P. R. in connection with the construction of their line between Sudbury and Sault Ste. Marie. Mr. Madden is ably assisted in the management by his accountant, Mr. Jno. Murrode.

The Indian City, with the Grand River bending round it, the picturesque scenery on its banks, and Mohawk Park, through which it flows, delights even the traveller who has climbed mountains, travelled through rocky Muskoka or languished in the salty breezes of the seaside, to come and spend a few months in this pretty town with its hospitable people.

Much of Brantford's popularity as a summer resort is due to the Brantford Street Railway Co. Last spring they purchased Mohawk Park on which they have already spent \$12,000—one of the most delightful spots in Canada. It comprises 42 acres, in which is an artificial lake. They cleaned the park up, built a quarter-mile bicycle board track, sodded the centre and erected a grand-stand capable of seating 1,500 persons, and a bleacher of 750 seating capacity. The track is surrounded with trees. Ten arc lights light up the track at night where large crowds assemble in the evening to witness the bicycle races. Fifteen arc lights are scat-

tered through the woods and on the edge of the lake. A large pavilion and casino were erected during the summer. A band plays there three nights a week, and a hungry or thirsty soul can eat or drink to the strains of Sousa's latest production, surrounded by 400 colored incandescent lights. The casino and pavilion thus illuminated present a very pleasing night effect from the lake.

The lake is a mile and a half in length by a mile in width supplied with water from the Grand River. The company propose to dam up the ravine in the park and allow the water to run through the ravine and over the dam. Behind the waterfall will be varied colored incandescent lights which at night will give a very pleasing effect. Bicycle boats and canoes are for hire, or you can step into your canoe at Oxford street bridge, and paddle twelve miles down the river, when you find yourself in Mohawk Park lake, only two miles from home, as the river is so crooked. You leave your canoe there, see the sights and take the street car back to the city. The Hamilton road leads from the city to Mohawk Park, and in one place there is a steep grade on which is a switch, but only one trolley wire, which is used for the car going up the grade on its way to the park. As the grade is steep the down car does not need a trolley wire on the down trip. As it shoots down the grade the lights go out, and this spot has come to be called "the tunnel." Mr. Madden has instructed his conductors to acquaint the passengers of its existence before they come to it, so that they may be prepared. The young people like "the tunnel."

The park was opened on the 24th of May, and on that date a railroad men's pic-nic came to town. The company collected on this inaugural day 18,000 fares. As a money maker no park can beat Mohawk Park.

On the eight and one-half miles of single track twelve cars run in the summer time, but in winter not so much service is required. The "T" rail is used exclusively,



BRANTFORD ELECTRIC RAILWAY—POWER STATION.

six miles weighing 30 lbs. and the balance 60 lbs.; any new rails will be 60 lbs. in weight.

The centre of the system is at the corner of Colborne and Market streets from which all the lines radiate. The main line runs east on Colborne, with a belt line around the eastern wards, via Alfred, Nelson, Brock and Arthur streets and Park ave., back west on Col-

borne to Brant ave., then north to the Institute for the Blind. Three cars cover this route.

The second line runs from the G. T. R. depot down Market street to the Kerby House on Colborne street making connections with all G. T. R. trains. As the distance is so short only one car is necessary on this route.

The third line terminates in West Brantford at one end and in Eagle Place, a southern suburb of Brantford, at the other. Its course is on Oxford street in West



BRANTFORD ELECTRIC RAILWAY—MOHAWK PARK.

Brantford, to Colborne street, then to Market street, south on Market street to Core street, Core street to Cockshutt road, to Eagle Place. Two cars cover this route.

The fourth line (operated only in summer) with six cars runs east on Colborne street from Market street to the Hamilton road, thence to Mohawk Park.

It took a great deal of persuasion by the company to induce the Council to allow them to lay their track on Colborne street from Alfred to Brock, a distance of three blocks, saving them the journey round the belt line on their way to Mohawk Park. After much contention the Council gave in, and the company therefore save a half a mile by a direct route to the park.

THE POWER HOUSE.

In keeping with the general excellence of the road is the power house, situated on Colborne street, near the G. T. R. tracks. The soil is something akin to quicksand and the foundation is sunk to a great depth. The reason of building here was that a stream ran through the property which affords a supply of water for condensing. The power station is a two-storey brick edifice with the top storey floor on a level with the street. In the annex of 40x40 ft. are the boilers and fuel. The main part is 80x50 ft., and the top storey is used for the general offices, waiting rooms, car storage and repair shops. In the basement of ground floor are the repair pits and lavatories, taking up the front part, while the rest of the building, 62x50 ft., comprises the engine and dynamo room.

The company do a good incandescent lighting business. Besides their railway machines, they have three alternators. The railway generators are two No. 32, 300 h.p. C. G. E. machines, and the alternators are: one 1,000 light C. G. E. and two 750 light C. G. E. machines with exciter. A 25 light "Wood" arc machine supplies the company with light for private purposes. The machines run from a line of shafting

extending the full length of the room, having two Goldie & McCulloch clutch couplings attached. Power is supplied by two "Wheelock" condensing engines of 150 h.p. each. From the boiler room steam is supplied from two Waterous and one Doty boiler of 150 h.p. each. The fuel used is Reynoldsville slack. Mr. D. C. Thomas is the chief engineer and is a young mechanic of great promise. An engineer and fireman are on for each twelve hour's run.

The wires are run from the switch-board to the ceiling, thence up through the tower on the side to the poles outside.

The switch-board is of wood panels, and the instruments are on slate bases. Mr. J. Watts is the electrical superintendent and has charge of all the outside work.

Thirty men constitute the regular staff, with fifteen additional in the summer.

The company have just issued a successful report, and as Brantford grows, as she certainly will do, the Brantford Street Railway Co. will by and bye take rank with the largest and most prosperous electric railway concerns of the Dominion.

ANNUAL MEETINGS.

OTTAWA ELECTRIC RAILWAY COMPANY.

The annual meeting of the above company was held on the 27th of January. The reports presented covered only a period of seven months, owing to the annual meeting, which was formerly held in June, having been changed to January.

The receipts from June 1st to December 31st, were \$122,694.39 for car fares, and \$5,479.59 from mail cars and other sources a total of \$128,173.98. The working expenses of the road were \$73,983.48, leaving a net profit of \$54,190.50. From this a two per cent dividend was declared on Sept. 2nd, a 2 per cent dividend on Dec. 2nd, and on January 9th a dividend of $\frac{1}{3}$ of 2



BRANTFORD ELECTRIC RAILWAY—MOHAWK PARK.

per cent., leaving a balance of \$10,106.50 to be applied to the profit and loss account. 2,843,173 passengers were carried during the seven months, and the wages paid out amounted to \$45,671.43. The assets of the company are valued at \$985,004.63, the profit and loss account amounting to \$57,808.05.

The election of directors resulted as follows: J. W. McRea, President; W. Y. Soper, Vice-President; T. Ahearn, Managing Director; G. P. Brophy, W. Scott,

P. Whelan and T. Workman. R. Quinn was appointed Auditor.

TORONTO STREET RAILWAY COMPANY.

The Toronto Street Railway Company held their annual meeting a fortnight ago. Mr. W. D. Matthews, a director of the C.P.R., was appointed a director, and at a subsequent meeting Mr. Jas. Ross, of Montreal, was elected vice-president to fill the vacancy on the board caused by the resignation of Mr. H. A. Everett. The directors were voted the sum of \$20,000 for their valuable services during the past year.

The annual statement submitted showed a net profit of \$301,310.30, as against a net profit of \$250,095.18 for the previous year. From the profits of this year two dividends at the rate of 1 1/4 per cent. each have been declared, amounting to \$210,000, leaving, after the deduction of an allowance for paying charges amounting to \$60,000, the sum of \$31,310.30 to be carried forward.

The company has in its treasury, bonds amounting to \$450,000 available for future use, notwithstanding the large expenditures which have been necessitated for rolling stock, car houses, etc. In the past four years the gross earnings have increased \$172,712.31, while the operating expenses have decreased \$100,418.50. The assets of the company are placed at \$9,775,511.70.

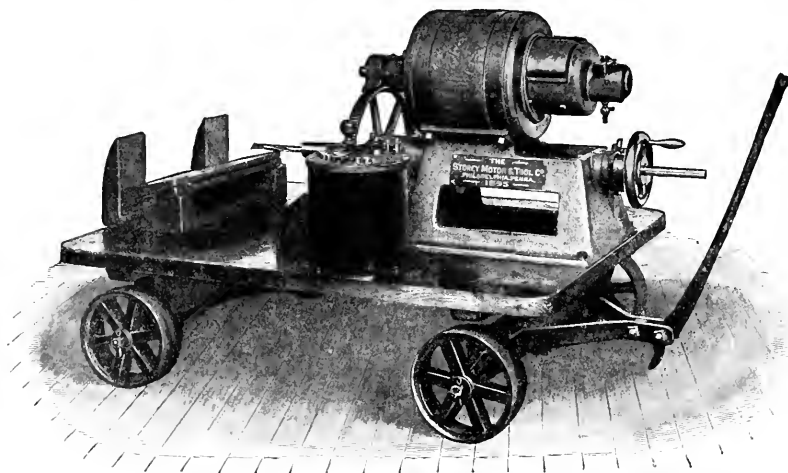
of March. Mr. Adam Rutherford was re-appointed secretary-treasurer.

The new management, it is said, propose to take steps at once to secure the extension of the road to Beamsville, and to make other improvements.

PORTABLE ELECTRIC DRILL.

THE Storey Motor and Tool Co., of Hamilton, Canada, and Philadelphia, Pa., some time ago put on the market a compact and efficient portable drill, which we illustrate herewith. This machine is adapted for drilling pig iron and copper for test work, drilling rails, and for various other kinds of work. Owing to the type of the motor, which is entirely enclosed, it is suitable not only for indoor work, but can also be used for outside purposes without requiring any specially arranged covering for fire protection. The outfit complete consists of motor and drill combined, together with regulating rheostat for obtaining desired speed, and a drum with 100 ft. of flexible cord, all mounted on a truck, with or without rack for holding material to be drilled, as desired. These machines drill in sizes up to 1 1/2 inches in steel and 2 inches in cast iron, and are furnished with both automatic and hand feeds.

The rapid adoption of electricity in machine shops and factories makes a tool of this kind extremely useful, as



PORTABLE ELECTRIC DRILL, MANUFACTURED BY STOREY MOTOR AND TOOL CO.

The comparative statement for 1895 and 1894 is as follows:—

	1895.	1894.
Gross earnings.....	\$992,800.80	\$958,370.74
Operating expenses.....	\$480,914.76	\$517,797.53
Net earnings.....	\$502,886.04	\$440,663.21
Passengers carried.....	23,353,228	22,609,338
Transfers.....	7,257,572	7,438,171
Percentage of operating expenses to earnings.....	49.3	54.0

During the year the company has built in its own shops 30 open cars, and 20 closed cars, five of which are 30 feet double truck cars, and six sweepers.

HAMILTON, GRIMSBY AND BEAMSVILLE ELECTRIC RAILWAY COMPANY.

At the annual meeting of the shareholders of the Hamilton, Grimsby and Beamsville Electric Railway Company held on the 27th ultimo, much interest was taken in the election of a directorate for the current year. There were two opposing forces, the Lester ticket and the Myles ticket. The former was successful, and the new board is therefore composed of T. W. Lester, president; John Hoodless, vice-president; C. J. Myles, John A. Bruce, John Gage, W. Grievs, and A. E. Jarvis (Toronto).

The secretary-treasurer presented a financial statement, the accuracy of which was questioned by the president. After considerable discussion it was resolved to consider the report at a meeting to be held on the 9th

it can be moved at will wherever it is needed. These drills can also be placed on a table or in any stationary position, and will cover a large range of work of different classes. As an illustration, two of these drills are mounted on bed-plates, one at each end of a large calender roll, drilling two holes in flanges at the same time and tapping them in the same operation, before the roll is moved. Another adaption of this drill is where it is fitted with a telescoping shaft and is used in yards for drilling holes in the construction of switches and crossings for street car and railroad work.

A different type of portable drill, combining all the features of an up-to-date drilling and tapping machine, is being brought out by the above company, and will be ready for the market in a few weeks.

PERSONAL.

Mr. Thomas Ahearn, of Ahearn & Soper, Ottawa, and Mrs. Ahearn, are at present making a tour of the world.

Mr. G. H. Campbell, manager of the Winnipeg Electric Street Railway, was recently in Toronto and Montreal on a holiday trip.

Mr. W. A. Handcock, local manager of the Bell Telephone Co. at Sherbrooke, Que., is receiving the congratulations of his friends upon his recent marriage.

Mr. J. J. York, chief engineer of the Board of Trade building, Montreal, and president of Montreal No. 1, C. A. S. E., was presented at Christmas by the employees in the building with a complimentary address, accompanied by a smoker's set, consisting of two valuable meerschaum and briar pipes and a large box of tobacco.

WHY CENTRAL STATION MEN SHOULD ORGANIZE.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—In your January number you publish an extract from a letter written by the manager of a company in an eastern Ontario town, to the manager of a company in a western Ontario town, and you derive from the remarks therein expressed, arguments why central station men should become members of the Canadian Electrical Association. In endorsing your remarks may I be permitted to carry the arguments a step further than editorial discretion prescribed as your limit? You describe the municipalities as the principal gainers by the want of organization among central station men, but it strikes me that the position is very different, and I am sure that a little careful reflection will convince anyone that it is the manufacturing companies who gain more—much more—than any one else by this want of combination and cordial co-operation, and who require to be watched much more than do the municipalities who are generally very mild offenders.

At the present moment the manufacturing companies maintain very curious relation with respect to the operating companies. They not only manufacture machines, which, of course, is their proper business, but they promote companies to do lighting business, then, as consulting engineers, they advise these companies as to what to purchase, and how to operate; and they endeavour to foster a kind of parent and offspring relationship with the view of opening and keeping a market for their own goods. Any attempt at independence of action on the part of the offspring is deprecated by the parent company, as tending to introduce an undesirable competition, and the manufacturing company also endeavors to guard its offspring against the bad men in the open market who would want to sell their goods by trying to constitute its agents the only means of communication between the operating company and the electrical world outside. These agents go around with their pack of goods, and while the customer is purchasing lamps, etc., they give him little scraps of news as to new apparatus, new installations, etc. A very large proportion of the smaller central station men seek for no better information on electrical matters than is dribbled out to them through the interested channel of a manufacturing company. They are satisfied to receive all their news, and any pointers they may require from the very man who is most interested in keeping them in the dark about the merits of any other apparatus than that which he himself sells.

Now, let any intelligent person consider for one moment what is inevitably the result of this. The central station man is interested in hearing of new or improved lamps, motors, etc., that have been brought out and by the use of which he can reduce his expenses, or extend his business. Is an agent likely to tell a customer of an improved type, made by a rival manufacturing company? Is he in the least likely to say that some rival sells a better lamp than he does himself? Is he not far more likely to religiously avoid mentioning any such thing? Can he be expected to recommend to, or bring to the notice of any customer, any piece of apparatus but that which he sells himself? Plainly, the purchaser, by not making independent enquiries, frequently fails to hear of something really to his advantage, because it is none of the agent's business to tell him.

A little reflection will show central station men how little they regard their own interests when they allow themselves to be kept in leading strings by the manufacturing companies, instead of combining to study central station practice for themselves. A manager should keep his eyes wide open to see things, to do the very best possible with what he has got, and to promptly seize hold of anything new that affords a means of reducing his expenses or extending his business. Now, any new labor-saving or more efficient piece of apparatus is patented and owned by only one company, and although it may be really the most valuable improve-

ment in the world, no other company is going to recommend its use if it will interfere with their own sales. On the whole, the central station man who expects a manufacturing company to give him really disinterested advice as to new or improved apparatus, is likely to be as badly left as he deserves to be. The enterprising man will hunt these things out for himself, by co-operating with his neighbors, to their mutual advantage. To illustrate: The storage battery has been proven to be of great value as a central station auxiliary. Has any Canadian manufacturing company ever recommended the installation of batteries? I do not think so. BECAUSE NO CANADIAN MANUFACTURING COMPANY MAKES A BATTERY THAT IS ANY GOOD. To recommend it would be to hurt their own business, which is to sell dynamos.

Again, plenty central stations using single phase alternating machinery, could work up a considerable day power business if they could get a good single phase alternating current motor. There is such a motor available, but I shall be very greatly surprised to hear that the agent of any of the Canadian manufacturing companies has mentioned the fact to any of their customers. Why? BECAUSE THEY DO NOT MAKE IT THEMSELVES, BUT HAVE DIFFERENT MACHINERY TO SELL, and it doesn't suit their business to post their customers too well on any good points in their rival's goods. A manufacturing company, if consulted, is going to advise the use of its own apparatus every time; and the demand for new and improved types must come from the central station man, who should use the most efficient, no matter who makes it, and find out for himself what is the latest and best.

As to operating central stations. Is there any manager who thinks he knows all about it? If so, why can't he let some other manager have the benefit of his knowledge? Perhaps he can get a few valuable hints in return. By all means let there be an organized body of central station men working together for their mutual good—telling each other what their experiences have been, and tackling their problems for themselves, instead of allowing themselves to be exploited by the manufacturing companies, who, in the words of a recent sufferer, have "hitherto had a pic-nic." Apologizing for this long letter, I remain,

Yours truly,

GEO. WHITE FRASER.

W. Kennedy, of Hobart, Ont., proposes shortly to put an electric light plant in his mill.

The second electric locomotive has been put in service in the B. & O. tunnel at Baltimore. It has improved on all previous performances by hauling a train weighing 1,400 tons through the tunnel at the rate of 23 miles an hour. In starting this train a draw pull of 58,030 pounds was exerted. The current taken was 4,100 amperes at a pressure of 600 volts.

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SPARKS.

J. F. Guay, a dealer in electrical supplies at Quebec, is reported to have assigned.

It is reported that an incandescent light plant will shortly be installed at Brussels, Ont.

The Aylmer Electric Light Co. are said to be considering the purchase of a 1,000-light incandescent dynamo.

The Nelson Electric Light Co. have recently put in operation their new plant at Nelson, B. C. Mr. John B. Bliss is electrician.

The Ira Cornwall Co. is being incorporated at St. John, N.B., to manufacture electrical apparatus, etc. The capital stock is \$10,000.

Alonzo T. Cross, a manufacturer of electrical appliances at Providence, R. I., has completed an electric carriage which is said to have given good results.

Mr. E. J. Lennox, architect, of Toronto, has recommended the purchase of an electric light plant for the new city and county buildings. The cost is estimated at \$15,000.

Mr. T. Vian, the promoter of an electric railway between Aylmer and Hull, Que., is forming a joint stock company to build the line. The cost of the work is placed at \$65,000. The electric road will be seven miles in length.

The Drummondville Electric Co., of Drummondville, Que., has been granted incorporation. The promoters are: William Mitchell, Samuel Newton, William Houston, A. Ouellette, of Drummondville, and W. A. Mitchell, of Nicolet.

Incorporation has been granted to the Barrie and Allandale Electric Street Railway Co. The promoters are J. H. McKeggie, G. Vair, G. Reedy, S. J. Sanford and J. H. Dickinson. The object of the company is to construct an electric railway in the vicinity of Barrie.

The Electrical Review, of London, Eng., in a recent issue compliments Mr. D. R. Street, of Ottawa, on his interesting paper on "Electric Light Accounting," read at the last annual meeting of the Canadian Electrical Association, and expresses approval of the various forms given therein.

At the annual meeting of the Maritime Auer Light Co., held at Fairville, N.B., recently, the following directors were elected for the ensuing year: Messrs. W. H. Thorne, W. C. Pitfield, R. Keltie Jones, G. S. Fisher and S. Hayward, St. John; A. O. Granger, Montreal; L. L. Beer, Charlottetown; F. W. Sumner, Moncton; F. B. Edgecombe, Fredericton.

The Toronto, Hamilton & Niagara Falls Electric Railway Co. has given notice of application to parliament next session for incorporation. The object is to construct an electric railway from Toronto to Hamilton, and from that city to Niagara Falls, Grimsby and Drummondville. The solicitors of the company are Messrs. Clark, Bowes, Hilton & Swabey, of Toronto.

The forty-ninth annual meeting of the Montreal Telegraph Company was held in the City of Montreal a fortnight ago. The assets were shown to be \$2,255,888.66, and the liabilities \$2,040,540.25. Four dividends of two per cent each had been paid. The election of directors resulted in the return of the old board, and at a subsequent meeting Mr. Andrew Allen was re-elected president.

A prize of \$75 and a diploma is being offered by the Verband Deutscher Elektrotechniker for the best device by which mistakes, such as placing the wrong size fuse in fuse terminals and the interchanging of fuses except by authorized persons, may be rendered impossible. The designs are to remain the property of the author, and must be received by the Verband at 3 Monbijouplatz before April 1st.

Mr. C. A. E. Carr, manager of the London Street Railway Co., recently gave a supper to the employees of the road.

Henry Townsend, whose son was killed in the Scarboro railway accident at Toronto last summer, has been awarded damages to the amount of \$1,000.

The Fraserville Electric Power Co., of Fraserville, Que., is applying for incorporation, with a capital stock of \$20,000, to operate telephone lines and electric lighting plants.

An employee of the Toronto Electric Light Co., while repairing the wires on Sherbourne street, in some way came in contact with a live wire, and was badly scorched about the hands and face.

A statement of the earnings of the Montreal Street Railway Co. for the quarter ending December 31, 1895, shows the receipts to be \$290,460.35 an increase over the corresponding quarter for 1894 of \$47,536.97.

At the annual meeting of the London Street Railway Co., held recently, the following directors for 1896 were appointed: H. A. Everett, of Cleveland, president; E. W. Moore, Cleveland, vice-president; Chas. W. Watson, Cleveland; Thomas H. Smallman, London, and H. F. Holt, Montreal. Chas. Currie was appointed secretary and Chas. E. A. Carr was re-engaged as manager.

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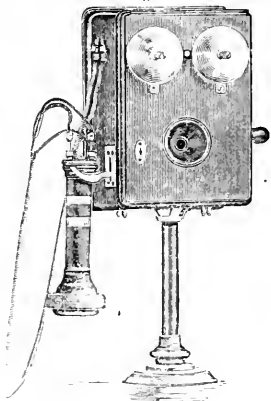
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CANADIAN
ELECTRICAL NEWS
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STEAM ENGINEERING JOURNAL.

VOL. VI.

MARCH, 1896

No. 3.

THE DUNNVILLE ELECTRIC LIGHT COMPANY'S NEW STATION.

A GRATIFYING feature of the development of electrical industries in Canada within the last three or four years has been the success of the incandescent lighting plants, especially in most of the smaller towns and villages. This success has been at once a source of benefit to the public, even in the smallest communities, in placing within their reach the most perfect of artificial illuminants at a cost but little, if any, in excess of that of coal oil, while at the same time it has yielded to the owners

of the plants a substantial return for the money invested. Such a result has been due partly to the great improvements in standard apparatus, and the better engineering methods adopted within the last few years, and also to a considerable degree to the recognition on the part of business men generally of the essentially profitable nature of electric lighting as an investment when handled with the same push and ability which they have been accustomed to devote to their other interests.

An excellent and recent example of a central station plant of this type is that recently installed by the Dunnville Electric Light Company, of Dunnville, Ont., a town of about 2,000 inhabitants. The company, which has been in business for some years, consists of two members, Messrs. W. F. Haskins and James Rolston, the former a private banker and the latter a hardware merchant in the town. Their plant, until recently, consisted of a Thomson-Houston arc dynamo operated by rented power. Having determined, however, to meet the growing demand for improved interior lighting, it was decided to add an incandescent machine to the plant, and at the same time to erect a new power house, and take advantage of an opportunity which presented itself of obtaining water power. To this end the company engaged the services of Mr. W. C. Johnson, Am. Soc. C. E., Chief Engineer of the Niagara Falls Hy-

draulic Power and Manufacturing Co., by whom plans and specifications were made for the entire hydraulic plant.

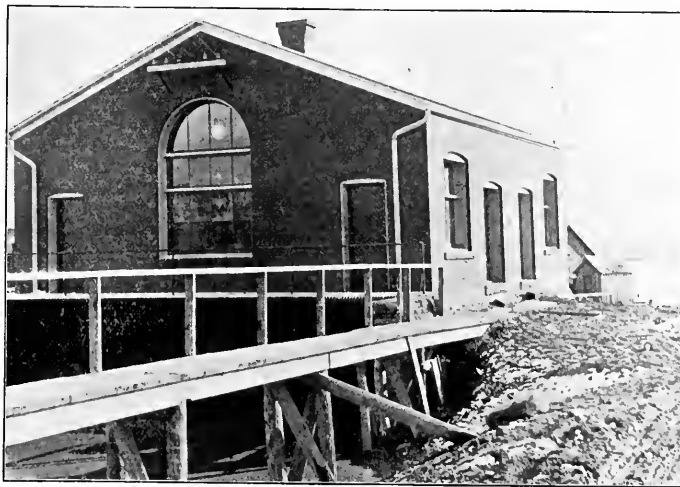
POWER PLANT.

Near the mouth of the Grand River, which flows into Lake Erie at Dunnville, a dam has been built by the Canadian Government for the purpose of supplying a feeder to the Welland Canal. This feeder, through the village of Dunnville, runs nearly parallel with the Lake Shore and some three hundred feet from it. The difference in level between the water in the feeder and the

lake varies from time to time from six to thirteen feet.

The electric light company's plant is located between this feeder and the lake, at a point about a thousand feet from the river.

The floor of the building is set as low as possible and to be sure of being above flood water of the river. The floor of the flume is fourteen feet below



THE DUNNVILLE ELECTRIC LIGHT COMPANY'S NEW STATION.

the floor of the station, and is about the same level as the bottom of the feeder, from which the supply of water is taken, and also about the same level as high water in the lake.

The principal difficulty in developing this water power arose from the fact of the low head available, combined with the very great fluctuations as compared with the head, the highest being more than double the lowest head. It follows, therefore, that a water wheel would be capable of developing more than double the power at some times than at others. On this account it was decided to put in two wheels in two independent flumes, so arranged that either or both of the two electric machines could be run by either or both water wheels. The water flows in one channel to the front of the building, passing through a rack, as shown in the engraving. At the front of the building a centre wall divides the channel into two parts, each provided with a head gate, by which the water can be shut off of either flume for repairs to the wheel.

Under ordinary circumstances one wheel is sufficient for driving the plant, and only one wheel will be used, the couplings being arranged with removable plates which can be taken out, cutting off either wheel from the line shaft, or by unshipping the coupling each machine is left attached to a single wheel. In low water both wheels will be used coupled together.

The wheels were specified to run at a uniform speed of sixty-six revolutions per minute under any and all heads from six to thirteen feet, and under all heads from six to nine and a half feet to develop not less than eighty horse-power; under all heads from nine and a half to thirteen feet to develop not less than one hundred and sixty horse-power, and to show an efficiency of not less than seventy per cent. of useful effect at seven-eighths to full gate opening when running at a speed of sixty-six revolutions per minute.

While this is not a high efficiency when wheels are run at their best speed, it is a high efficiency under the unusual requirements as to speed. The wheel of the proper size to run at sixty-six revolutions per minute under a head of six feet, would give its best efficiency under a head of thirteen feet when running at about one hundred revolutions per minute.

The contract on the wheels was awarded to James Leffel & Company, of Springfield, Ohio, for two of their "Sampson" wheels, sixty-two inches in diameter, and they have been running for several months and are giving good satisfaction.

The wheels are provided with draft tubes, enabling the entire available head to be used when the level of the water in the lake is below the bottom of the wheels.

Since the wheels have been in operation a period of low water has occurred, when the lake level was but just above the end of the draft tubes and the head water but little more than covered the cases of the wheels. No trouble was experienced in operation.

The shafting, floor stands, pulleys, etc., were furnished by the Watrous Engine Co., of Brantford.

The flume walls were built of stone laid in hydraulic cement, upon a flooring of brick bedded in concrete. The walls above the foundations were built of brick without finish on the inside.

The roof consisted of sheeting of two inch plank laid on iron beams imbedded in the walls and covered with slate, making the whole building practically fire-proof.

A brick partition wall divides the gear room from the room containing the electric machinery, which serves to deaden the sound of the gears and affords a protection in case of fire.

At one side of the machine room two small rooms are partitioned off, one for an office and the other for a work room. A loft over the gear room serves as a store room.

ELECTRIC PLANT.

In the station are installed the Thomson-Houston arc machine, by which the street lighting is supplied, and a 75 kilowatt alternator of the Canadian General Electric Co.'s monocyclic type. The company, in selecting the monocyclic system, were guided by the fact that while their present requirements would be for current for incandescent lighting, and while this would continue to furnish the greater portion of their business, there would no doubt in time be developed a considerable field for the supply of power to stationary motors. It was therefore desirable to install a system in which the greatest possible simplicity should be maintained for

the lighting circuits, and from which, at the same time, polyphase currents could be maintained, if desired, for the operation of induction motors. The distinctive feature of the monocyclic system is, of course, its special suitability for this class of service. The lighting being done on the single-phase system avoids the complication in wiring and difficulties in balancing attendant on the use of the various polyphase systems, while, for the supply of power to the motor at any given point, it is only necessary to carry to it the third or teaser wire from the dynamo, and make the proper transformer connection.

The alternator is in design of the well known iron-clad armature type, and is compound wound so as to compensate automatically for line losses, and thereby maintain an even potential at the centre of distribution throughout all changes on load. The armature coils are wound on forms and inserted in longitudinal grooves in the surface of the armature, and are easily and separately removable in case of damage to one or more coils. The station instruments are all of the latest type, and handsomely mounted on a switch-board of enamelled black slate.

A feature of special interest in this plant is the use throughout of the Edison three-wire system for secondary distribution, by which a considerable saving in transformer capacity and secondary wiring is claimed to be effected, while at the same time ensuring a higher efficiency and closer regulation for the entire secondary system. Through that portion of the town where lighting is to be supplied, three-wire secondary mains are run and fed at intervals of 1,000 to 1,500 feet by pairs of large transformers, connected with their secondaries in series to give 208 volts. This system of distribution being once erected, the wiring of additional buildings from time to time calls for no additional expenditure for material, beyond that required in running a service from the mains to the building wired.

Altogether the new plant of the Dunnville Electric Light Company is a credit at once to its enterprising owners, Messrs. Haskins & Rolston, and to Mr. W. C. Johnson, consulting engineer, and the contractors who furnished the apparatus and material used throughout.

An interesting use of magnetism is being made at the Sandycroft foundry in England. At these works electric cranes are operated from the electric power and lighting circuits, together with electro-magnets, which permit the ready lifting of pieces of iron or steel up to two tons. The magnets constructed for lifting purposes are attached to a crane. One magnet takes $5\frac{1}{2}$ amperes at 110 volts to excite it, at which energy it will support a weight of two tons of iron or steel. A switch controls the supply of current delivered to the magnet.

Ampere, like other philosophers, was noted for his absent-mindedness, says the London Electrical Engineer. It is stated that on one occasion while walking along the street he mistook the back of a cab for a blackboard, and as a blackboard was just the thing he needed at the time to solve a problem which had been vexing his mind for some moments during his walk, he made use of it. Taking a piece of chalk out of his pocket he proceeded to trace out a number of algebraical formulæ on the cab's back, and followed the moving "board" for the space of a quarter of an hour without noticing the progress of the conveyance.

CORRESPONDENCE

THE PIONEER ELECTRIC RAILWAY OF CANADA.

TORONTO, Feb. 13, 1896.

Editor CANADIAN ELECTRICAL NEWS.

SIR, A cynical writer has remarked that "without lies we should have no histories," and since reading a presumably historical account of the first electric railway in Canada, contained in Cassiers' Magazine for January, I begin to believe that the cynic's opinion was founded on fact, as the source of the supposed historical account must have either been densely ignorant of the facts or fully qualified for the presidency of an Annanias Club. An accurate account of the experiment of 1883 may be worthy of preservation; if such be your opinion, you are free to publish this account, which is accurate.

The electric railway experiment of 1883 was at the expense of the Ball Electric Light Co., of Canada, and was carried out by Frank B. Scovell, the Vice-Pres. and Electrical Engineer of that company, assisted by the writer, who was then assistant electrician of the Ball Electric Light Co., of New York therefore, this account is neither a matter of rumor nor of imagination.

The track consisted of eight lengths of common railway T rails, spiked to common ties, laid on the surface of the ground, on the premises of the Industrial Exhibition in Toronto—about where the iron tower or police station are a present located. The car was an ordinary flat car.

The transmission was by overhead wires from Machinery Hall to the track. One line was coupled to both tracks and the other to a bare copper wire which lay on the ties between the rails. Contact with this wire was maintained by a carrier, which lifted the wire off the ties as it passed back and forth. As the track was perfectly straight, this was satisfactory, there being no tendency to pull the wire against the rails, as might have been the case with curves. The motor equipment was an old style Ball machine, built in London, Ont., and the power plant two similar machines. Each of these would at regular speed operate at 200 volts with 15 amperes, but being designed for arc lighting the armature reaction would rapidly run the voltage and torque down with increase of amperage. The motor was belted to a countershaft and that to one pair of axles, by common flat leather belting. The reduction in speed proved insufficient to enable the motor to move the car up the slight grade, though it was capable of doing so on the level and down the grade; up the grade it required a couple of men to assist, even with an unloaded car. The intention was to carry passengers as a novelty, but owing to the above fact this was not attempted as a matter of fact, as the Exhibition closed before the necessary changes could be effected. A very little more motive power or less attempt at speeding would have enabled us to have carried out the intention, and engineers of that time will remember that we had no guide but the result of our own experiments, and judge Mr. Scovell rather by the measure of success secured than by the want of full success, due solely to want of information that is so readily secured now by the tables and published results of experiments that are almost universally disseminated among engineers of the present day.

The company mentioned in Cassiers' did not come into existence until about ten years later than the date of

this experiment, and I am informed that the head of this company was then engaged in button-making in Springfield, Mass. The view therein given as one of the road of 1883, and the information as to carrying passengers, I believe, is really applicable to the road built and operated by Mr. J. J. Wright, under the Van Depoele patents, I think in 1884 or 1885. The fact that Mr. Scovell has since departed this life may possibly explain the inaccurate account given in Cassiers', as so far as I know he and I were alone acquainted with the facts.

Yours respectfully,

JAMES W. EASTON,
Electrical Engineer.

ELECTRIC RAILWAY IMPROVEMENTS.

TORONTO, Feb. 21st, 1896.

Editor CANADIAN ELECTRICAL NEWS.

Dear Sir,—The writer of this has always heard Hamilton spoken of as being behind the times and an overgrown village, and other uncomplimentary remarks made about it—as being behind the age, yet a visit there a few days ago showed that, even if the town is a little behind the times, the people are not so bad. I had the pleasure of a trip over The Hamilton, Grimsby & Beamsville Railway in company with Mr. C. K. Green, Chief Electrician. You are aware, no doubt, that this railway runs from Hamilton to Grimsby seventeen miles—through the Garden of Canada. On boarding the car at Hamilton Mr. Green promised me a surprise, and this I got, as I found that when the trolley was put on the wire the headlight shone out clear and bright—an arc lamp, which, on the run from Hamilton to Grimsby, illuminated the track as clear as daylight from six to eight pole-lengths in advance of the car, one-half of which was more than sufficient to stop the car in case of anything being on the track. The arc lamp is in series with the car heaters, gives a clear, bright and steady light, and is easily controlled by the motor-man. The mechanism, and in fact the idea, seems to have originated with Mr. Green.

After admiring the beauties of the arc lamp, and the splendid way in which it lit up the track, Mr. Green gave us another surprise in the way of communicating by telephone with any station on their line from inside of the cars. In the corner, in one end of the car, a small open box is affixed to the wall; in this a very small telephone is enclosed, and attached to the telephone is a flexible cable of sufficient length to reach the telephone wires running on the poles of the railway company. These are hooked on by a bamboo pole, which is carried on the outside of the car. Communications can be established with any station from any point of the line in this manner. As a magneto the same as is used on the ordinary telephone would be too cumbersome to put in the car, Mr. Greene arranged a small metallic roller having a perforated disc, and this being moved from point to point would give a vibrating current, which would make a magneto on any point of the line ring. Altogether, the arrangement is about as complete as could be wished for.

The arc lamp, used in the way it is on this line, is the first practical application of it in Canada, and telephoning from the cars, while not being something absolutely new, yet speaks well for the enterprise of Mr. Green in meeting the conditions, which can only be found in a long suburban road.

A TRAVELLER.

MR. JOSEPH R. ROY.



MR. JOSEPH R. ROY.

THE chief engineer of the Montreal Park & Island Railway Company is Mr. Joseph R. Roy, whose portrait we have the pleasure of presenting herewith. He is a native of Montreal, and a graduate in engineering of McGill University. He is also a member of the Canadian Society of Civil Engineers. Mr. Roy was for three years employed by the Department of Public Works, and at a later date was appointed resident engineer in charge of the construction of the Massini springs and Fort Covington railway. He then became chief engineer of the Montreal and Ottawa railway, which position he held until the year 1892, when the road was made a part of the Canadian Pacific railway.

THE ELECTRICAL PLANT AT NIAGARA FALLS.

THE following notes are the result of a visit by a Canadian electrician to this plant of world wide interest and observation which is now in successful operation. The Niagara Falls Power Co. owns about 1,500 acres which it expects to sell or lease to manufacturing companies using its power. The user of the power may put in his own water wheel, renting the use of the tunnel as a tail race, or he may take his power from the shaft of the Niagara Co., or use the electric power itself. So much power is being taken up by companies in the immediate vicinity, that long distance transmission is likely to be delayed for a year or two at least.

About 3,000 h. p. is now being utilized, distributed as follows:—Pittsburgh Reduction Co., 1,500 to 2,000 h. p.; Carborundum Co., 1,000 h. p., and Street Railway Co., 500 h. p. This is handled by one of the two 3,000 h. p. generators now in place. The third, which completes the order placed with the Westinghouse Electric & Manufacturing Co., is expected in two weeks. As the power is rapidly being taken up, it is likely that bids for new generators will soon be called for.

One cannot but be impressed by the thoroughness and lasting qualities of all work done in and about the power house. Even the visitor is provided for, in the shape of a gallery, from which a fine view of the station can be had. All heavy apparatus is easily handled by a 50 ton crane running the length of the station. The armature, the heaviest part of the generator, weighs about 35 tons. The whole revolving part of the machinery, field shaft and turbines, weighs about 65 tons. But this great weight, revolving at 250 revolutions per minute, is almost entirely balanced by the water pressure, which acts upwards on the lower side of the turbines. So much is this the case, that the strain on the thrust bearings is estimated at not more than 2 tons when the machine is running. At some loads there is no pressure on the bearings whatever, the whole weight being supported by the column of water. The speed is regulated by ball governor mechanism shifting two gates which are balanced against each other and require extremely little power to move them.

The fields are excited from rotary transformers driven by the generators themselves and placed near the central vault supporting the switchboards. There is also a step-down transformer with each rotary transformer.

All wires are carried under the floor to a vault in the centre of the station. In this vault the switches, moved by compressed air are placed. The bus bars are suspended from the roof of the vault and connections made to the switches which stand on the floor. There are two switches to each generator, a distributing switch and a generator switch. The field rheostats are not placed in the vault, being too bulky, but the connections from them are all brought in here. All instruments and levers, for regulating the switches, etc., are placed on top of the vault. This is surrounded by a brass railing, and here the electrical engineer in charge has a view of the whole station and perfect control over the electrical apparatus. The instruments consist of the ammeters and two volt meters (one for each phase) and one watt meter for each machine. It may be mentioned here that the two legs of the two-phase circuit bear loads which differ considerably, due to single phase current being rented in some cases. The step-up transformers for long distance transmission are provided with a special building across the canal. Lightning arresters are provided for all circuits leaving the power house.

Street railway power is furnished from a 500 h. p. rotary converter, built by the Westinghouse Co.

Power is transmitted to the transformer house of the Pittsburgh Reduction Co., near by, where it is reduced to a pressure of 115 volts and transformed by rotary converters to direct current at 160 volts, ready for use in the reducing furnaces in the production of aluminum. There are four rotary converters of 500 h. p. each, built by the General Electric Co. They are of very large size, but were so made that they might be increased, when necessary, to 1,000 h. p. each, by changing the armatures. If necessary one of these machines can be started up in 3 minutes, and the whole station in 11 minutes. Such rapid starting up would be impossible in the case of a steam plant. Indeed one is greatly impressed here by the absence of anything in the shape of a tall chimney and smoke. The load is pretty steady and power is kept on day and night. About 6 tons of aluminum is turned out every 24 hours.

The Carborundum Co. also receives its power in a step down transformer whence it passes through a regulator of special construction moved by hand. The regulator is required on account of the variable pressure necessary during the heating process. It is a transformer in which the mutual induction is varied by turning the inner part of the apparatus and its windings, the outer part being fixed. 1000 h. p. is used, one furnace being in operation at a time. A heat lasts for 24 hours, a ton of carborundum being turned out at each heat. The ingredients consist of coke, salt, sand and sawdust. These are thoroughly ground up and mixed before being put into the furnace. The electric conductors are connected to plates at opposite ends of the furnace. From each of these plates 36 carbon cylinders project into the furnace. A sort of conductor of coke is lain through the middle of the furnace from one terminal to the other and the carborundum crystals are formed around this. These crystals are washed in sulphuric acid and then in water, from which latter bath the carborundum is obtained and sorted in sieves into different sizes ready for the factory. At present it is sent to the factory at Monongahela, Pa., where it is made into wheels and cones of all sizes for various grinding purposes. A factory is being built at Niagara, and when it is complete, the other will be shut down. The process is very much cheapened by the use of the Niagara power.

QUESTIONS AND ANSWERS.

F. & T., Walkerton, Ont., write :—1st. Why cannot alternating current be used instead of direct for street railway purposes? 2nd. What is the difficulty in using same? Our opinion is, that with double wiring twin trolleys, two commutators and rawhide gear, feed wire and transformers, with a few minor changes in the method now in use, it would be possible, and at a very reduced rate. Will some one give us their opinion on the same?

ANSWER.—The alternating current has not hitherto been used for street railway purposes, first on account of the unsuitability of the alternating motors for the conditions imposed on railway motors, their torques at other than full speed not having been satisfactory. This defect has been overcome in the induction motor, which is no doubt adapted for traction purposes, and probably will be so applied in the near future. By your mention of twin trolleys you no doubt mean to throw out the rails as return circuit, but in any case the single phase alternating current would not be at all suitable for traction, as single phase motors will not start from rest without introducing a complicated phase-splitting apparatus, so that you would either have to use a two phase current with four wires, four trolleys, etc., or a three phase with three wires, three trolleys, and so on. You mention two "commutators," but it does not appear what a commutator has to do with an alternating current. The alternating current is scientifically applicable for traction, but not commercially as yet.

The Secretary of Dresden Association C.A.S.E., proposes the following question :—"What is the indicated h.p. of an engine, 13 in. bore, 18 in. stroke, 170 revolutions per minute, boiler pressure, 70 lbs.?"

ANSWER.—The indicated horse-power of our engine is calculated from the formula

$$H.P. = \frac{A \times M.E.P. \times R \times S}{33,000}$$

where A. = area of piston in square inches; M.E.P. = the mean effective steam pressure; R. = number of revolutions; S. = length of stroke in feet. In the case mentioned, the piston area in inches is 132.73; the mean effective pressure at one-quarter cut-off is (with 70 lbs. boiler pressure) 29.63 lbs., non-condensing; the stroke is practically 1.5 foot hence, substituting in the formula, we get

$$H.P. = \frac{(132.73 \times 29.63) \times (2 \times 170 \times 1.5)}{33,000}$$

which is a little over 44 horse-power.

WALKERVILLE, ONT., Feb. 12, 1896.

Editor CANADIAN ELECTRICAL NEWS.

DEAR SIR,—I notice in the "Questions and Answers" column of the NEWS a query from "Constant Reader," Whitby, Ont. He asks, "How is it, when lamps are connected in series, as in railway circuits, the highest voltage lamp always gives the brightest light?" With your permission I would like to state my theory contained in the following table and explanations :

16 C. P. LAMPS, 60 WATT EFFICIENCY.

Volts.	Amperes.	Hot Resistance in Ohms.	Lamps of any efficiency can be taken provided all are alike.
50	1.2	41.66	
70	.875	81.77	
100	.6	166.66	
104	.577	180.24	
110	.5454	201.68	

With a circuit of 500 volts, using five lamps in series, suppose four lamps of a series are 100 volts and one lamp 104 volts, then by adding the resistance of the five lamps, we obtain 846.9 ohms ($166.66 \times 4 = 666.66 + (1 \times 180.24) = 846.9$). Applying Ohm's law we get the current required,

$$\frac{500 \text{ volts}}{846.9 \text{ ohms}} = .59 \text{ ampere } C. = \frac{E}{R}.$$

By comparing the result (.59 amp.) with the table, it will be seen that the current passing through the series is .013 amp. less than is required for the 100-volt lamps,

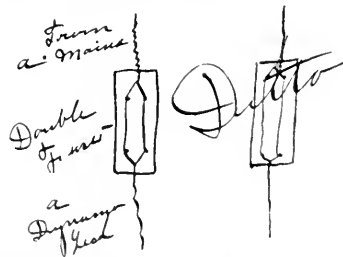
and .01 amp. more than is required to bring the 104-volt lamp to 16 c.p. The practical result is that the 100-volt lamps will burn a little below and the 104-volt lamp a little above the normal, making a perceptible difference in the light. Lamps of the same voltage but of different efficiencies will give similar results. The higher efficiency lamps being of higher resistance and requiring less current, will give the brighter light, e. g., 55-watt and 60-watt lamps connected in series, the 55-watt lamps will be the brightest. Nothing but a test will show whether it is the efficiency or voltage that is at fault if some lights in a series burn bright or dim.

J. W. SCHELL.

"P. S. C.," Oshawa, Ont., writes :—Please be so kind as to answer me the following questions in the March issue of the ELECTRICAL NEWS: (1.) "Suppose after two guages of water show in glass that pump was stopped; five minutes after that you notice water at the top of glass, what would you do, and what was the cause of difficulty, boiler not foaming? (2.) Suppose feed-pump working, but water level in boiler gradually falling. Name the different places you would look to find the difficulty? (3.) If the valve stem of the steam valve of a Corliss engine should break, what could be done to prevent a shut down? (4.) In triple engine, with second cylinder doing much more work than low pressure, how can cut-off be best adjusted in either cylinder to balance load between cylinders?"

ANSWER.—(1.) We should advise you to blow out the gauge glass to see if the level indicated was the right one, or whether in some way the gauge cocks had become clogged. If, as a matter of fact, the level of the water was above the glass (and the gauge had become so clogged as not to indicate properly,) open the pet cocks of the cylinder, and the drain in the pipes, so as to carry off the water flowing into the pipes. If no further trouble occurred in the cylinders wait until water appears again in the gauge glass, but if there is any reason to fear that the water level is so high as to flow over into the cylinder, then blow the boiler down a little. (2.) Either the pump is not working fast enough or water is leaking at joints or seams, or around the tubes, or at the blow-off. In fact, overhaul the boiler immediately? (3.) Splice the stem temporarily with anything—a piece of stiff wood—and wrap the stem and splice with some stout cord or rope, drawing the valves together, so as to keep the whole thing taut. (4.) You can do nothing unless the cylinders are individually controlled by a cut-off valve, in which case adjust as in a single cylinder.

"W. R. R.," Stayner, Ont., writes :—"To protect our alternator from short circuit in the outside mains, there is, as is of course the practice, a fuse introduced between the dynamo leads and the main—but in our fuse cut-out there is, I think, something peculiar, if not out of place. Each wire has a separate cut-out. The following diagram shows the whole as it is :



The reason given for the double fusing on each line is, "if one should be blown out, the other would still be there to prevent the interruption of the circuit." Is this in place?"

ANSWER.—The two fuses are intended to be duplicates, so that if one goes there may still be the other which can be switched or plugged in. There should be

some arrangement for switching one off and the other on; but of course both should not be in circuit together.

Mr. F. G. Proutt, of Malden, Mass., writes: I noticed in your paper of this month a communication from some one who signs himself "A Constant Reader." From the question he has asked, and which you took so much trouble to answer, I imagine that he is not a constant observer, but to help you complete the answer to his question, the reason a high voltage lamp becomes more incandescent than those of a lower voltage when connected with them in series, is this: The higher voltage lamp the less current passes through it, or, rather, is required by it; for instance, about $\frac{1}{2}$ ampere is required for a 100 volt lamp, while one ampere, or about that, is required for a 50 volt lamp. Now, if we connect 8 50 volt lamps and 1 100 volt lamp in series across a 500 volt circuit, we would have current passing in proportion to the resistance, and if the 50 volt lamps have each 50 ohms R, and the 100 volt lamp an R of 200 ohms, then

$$\frac{E}{R} = C \text{ or } \frac{500}{8 \times 50 + 200} = C = 5.6 \text{ amp.}$$

Now, 5.6 of an amp. is not quite enough current for the 50 volt lamp, but is very much too high for the 100 volt lamp. Hence, the high voltage lamp would burn very much brighter, and in every case where lamps of different voltages are run in series, the one made to be at the highest voltage will be the most incandescent.

CENTRAL STATION BOOK-KEEPING.

By GEORGE WHITE-FRANER, E. E.

III.

WHAT has gone before will indicate the importance of keeping strict watch on the operating end of an electric plant. As soon as you begin to suspect the honesty and faithfulness of each piece of machinery in your power house, and lay traps to find out little lapses from rectitude, so soon will you begin to find your expenses going down, and your profits increasing.

When you look into things a little, you will be surprised to find what a great deal there is in "management" after all; and how even apparently unimportant apparatus and supplies may exercise a considerable influence on results. Lines are of course very simple, and once they are up will probably continue to be all right, if they are kept free from grounds, and generally kept in repair; but at the same time it is of considerable assistance to take observations from time to time, as to the insulation of the entire aerial structure, from the ground, and of the wires from each other. A leak in either way simply means wasted fuel, and presumably the business of a central station is to make, not to waste, money.

From the central station, the records will divide into these concerning arc services, incandescent service, and power service. As regards the arcs, there should of course be an account kept of the carbons used, and of the repairs necessary on each lamp. An account should be kept for each individual lamp, and the cost of any repairs to any one should be debited against it. If a coil burns out—or a carbon holder—you want to know of it, and which lamp it belonged to; and you can summarize the records at the end of the year, and probably have some instructive information as to the quality of your lamps as pieces of mechanism. Then, a few spare lamps should always be kept in stock in order to replace those on the lines brought in for inspection. Perhaps the idea of inspecting an arc lamp causes amusement; but when it is remembered that an arc lamp is merely a little machine for keeping carbons at a proper distance apart, and that it does so by virtue of being built and adjusted with that object, and that its proper working depends on some rather delicate devices, and that if it falls ever so little out of adjustment, it means wasted money for fuel—then it will be obvious, that to inspect it periodically, to see whether it actually is doing its work, is just as necessary as it is to indicate the engine.

What is an "arc light," and how is it produced? An arc light is simply the illumination produced by the intense incandescence of two "electrodes" separated by a space across which an electric current is being forced by an E. M. F. This incandescence is the result of the very high temperature caused in the electrodes by the interposition of the air space—it being a principle of mechanics as well as electrics that resistance dissipates energy in the form of heat. A greater amount of resistance will dissipate a greater amount of energy. A man will become hot and perspire when working hard, i.e., overcoming a great resistance, when he will not even feel warm over a light job; and as the principal

work done by the current in passing through an arc lamp is right at the arc itself, it is plain that the longer the arc the more work done. Now, it is well known that a current of 9 amperes requires a voltage of 50 to force it across an air space of about .3-32 of an inch between the carbons, and the light produced is the nominal 2,000 candle-power. So that if you can arrange to have two 7-16 carbons continually held at 3-32 apart, and use a 9 ampere current, you will get nominal 2,000 c.p., and will require a pressure of 50 volts, or an expenditure of $50 \times 9 = 450$ watts of energy. If you vary the distance apart of the carbons, you will vary, in the same sense, the volts, wattage, and within limits, the candle-power. If you keep the carbons 4-32" apart you will get a somewhat larger candle-power, and you will require a higher voltage and expend a higher wattage. But as you are only getting paid for 2,000 c.p., you don't want to produce any more—hence the excess of wattage consequent upon higher c.p. is a pure waste of money. Every time your arc lamp pulls the carbons apart more than their rated arc length; every time the carbon rod sticks a little—generally, whenever your arc gets longer than it is intended to—you are wasting fuel, and consequently, money. With a 9 ampere current, an excessive voltage of so little as one-tenth of a volt, will require an expenditure of almost 3 h.p. hours per year—more than necessary—per lamp.

Try any lamp that has been on the line for some weeks, exposed to all the variable atmospheric conditions, and a few careful observations as to the fall of pressure across the terminals will be very instructive to anyone who is intelligent enough to apply the results. Assume 30 arc lamps, burning on a moon schedule of about 200 hours in the month, and assume that their adjustment is to become so inaccurate that they will draw out their arcs long enough before feeding to require an extra volt each. Assume that otherwise their working is reasonably good, and their feeding regular; then this plant will dissipate in excessive voltage alone, 432 h. p. hours every year, which might just as well be saved.

Every lamp should be tested for a whole night every two or three months. If its feeding is not regular it should be made so, by the proper adjustments, which can be done by any intelligent electrician; and the record of each lamp's performance should be kept. If any individual lamp is frequently found to be out of adjustment, it should be carefully overhauled. It may have some defect which renders it inefficient, and which can perhaps be remedied. If not, it is better to buy a new lamp than to run a bad one. By lighting the power house with the lamp to be tested, no extra expense will be involved.

It is quite important that tests should be made of the carbons. A carbon is by no means always a carbon. There are good, bad, and indifferent ones. The good will cost money to buy, it is true; but the poor one will cost money to run, it is equally true. There are hard and soft, long-lived and short-lived, cheap and expensive ones. Those who have not given any study to the carbon question generally believe that carbon is the best that lasts the longest, but that does not necessarily follow. Carbon is a material of comparatively high resistance, which can, however, be varied by varying its density and its ingredients. Cheap carbons are made of inferior materials, and not a great deal of attention is paid to the process of manufacture. The consequence is probably a very high resistance, and a want of homogeneity in the structure which causes it to burn unequally and break off in little chunks. It may have a long life, but the high resistance will cause the same extra expenditure over that required for a shorter lived, lower resistance carbon, as the undue lengthening of the arc described above. It may very easily happen that a short-lived carbon may be the most economical to use, because its smaller resistance will save more than enough energy to pay for the greater number of carbons used. Observation and experiment will enable the intelligent electrician to select actually the best carbon; and a certain number of each batch bought should be carefully tested as to their life, their resistance, and if possible, their candle-power. This latter point—candle-power—is of course very important, but to properly describe the tests and observations would require too long an article. Careful observations by experienced scientists have proved that carbons of the same apparent make, from different makers, sometimes vary as much as 50 per cent. in the candle-powers they give forth, for the same expenditure of energy; and they show that ultimately the best carbon is undoubtedly that one to the manufacture of which most scientific attention has been given, which is therefore necessarily high priced. But the test above mentioned should be made with a carefully regulated lamp, so that the arc shall be kept sensibly constant, and should record the exact length of life per inch and per carbon, and the average

resistance across the lamp terminals. These records will enable a fairly good comparison to be made between carbons of different makes and prices. If, by a proper system of lamp inspection and adjustment, and a careful selection of carbons, you can run each lamp at one volt less pressure, in the above assumed plant you will save over two tons of coal per year; or you will be able to put another lamp on the same circuit.

As regards the incandescent installation, about the most important feature is the lamps themselves; and this is the feature that seems to receive less attention and study from the average central station manager than any other. Lamps are of all kinds, sizes, makes and descriptions; and of course each manufacturer claims superiority for his own make. Price seems generally to be regarded as the most important factor governing the selection of a lamp, i.e., a lamp costing 22 cents is taken to be a more advantageous purchase than another costing 23 cents. As I have frequently said before, it is a pretty fair principle to work on in these days of keen competition among manufacturers, that the highest priced article is generally the best one; and the question to ask is, not how little does such an article cost to buy, but how little does it cost to keep running in good order. An article that can be kept in repair and in good efficient condition for \$1 a year, is worth, to buy, just twice as much as a similar article that costs \$2 per year to maintain, other things being equal; and if the former article is sold at 50 per cent. advance on the price of the latter, then the higher priced article is actually and obviously far the cheaper of the two. This same principle applies to incandescent lamps. The factors that determine the comparative values of different lamps are: the candle-power, the life, the efficiency, the price—purposely putting price last. Lamps of all makes deteriorate as they are longer in use, some less than others, i.e., their candle-powers become, sometimes, considerably less the longer they are kept burning; and the lamp to be desired is, other things being equal, that one that keeps its candle-power longest up to its rated amount. Then again, lamps differ in point of efficiency. A lamp requires the expenditure of a certain amount of energy to make and keep it burning; so that other things being equal, that lamp that maintains its candle-power longest, for the least expenditure of energy, is the best. Having obtained by means of experiment or otherwise, a diagram showing the continuous candle-power curve of a lamp as a function of its life, and also of the watts of electrical energy expended during inch life, then an average can be struck which shows the average watts per candle-power expended. And a comparison of several such averages will show the best lamp, other things being equal. The best is of course that lamp which requires the lowest average wattage per candle.

About the only other record that can be kept in places where lamps are rented on the flat rate system, is the dates when each lamp was put in. A little slip of paper with the date marked on it can be gummed onto the base, and so accurate track is kept of the life of each lamp, which can be returned to makers if burnt out before guarantee.

If the entire system is worked on the meter plan, which is greatly to be preferred, then the monthly readings of the meters added together should be compared with the month's total as registered on the station wattmeter. The comparison will enable any discrepancy to be traced and possibly lead to the detection of unsuspected leaks.

In a system where current is sold entirely by the meter it becomes of very special importance to study the incandescent lamp question, because the exigencies of this service introduce some very paradoxical conclusions. For instance, it is sometimes actually better and more profitable for the central station to break lamps long before they are worn out, and put in new ones at its own cost. Length of life, in this case, is about the least important advantage that can be claimed for a lamp. This, however, is a matter that cannot be discussed at proper length in this article. What is intended to be shown is, that just as there are engines and engines, dynamos and dynamos, so are there carbons and carbons, lamps and lamps, and that if judgment and caution are necessary in the purchase of a bicycle, or of a good horse—they are far more so in the purchase and operation of any electrical and steam apparatus.

There are certain general accounts that will be kept by every one—sand paper, oil, new brushes, fuse wire, and what not, which need not be particularly referred to. A central station that follows the line of the records indicated in the foregoing, will find itself in a good position to increase its profits. In electrical business it is not entirely what is made that pays dividends, but what is saved; and it cannot be said of even the most high class station

yet known, that it has attained the highest possible point of efficiency, but the most successful are those that keep the most watchful eye over every individual machine or piece of apparatus, and who keep every detail in the highest and best order—and this cannot be done without keeping the most comprehensive system of accurate records, and by the continual testing of everything.

ANNUAL MEETING OF THE BELL TELEPHONE COMPANY.

THE annual meeting of the Bell Telephone Company was held in Montreal on the 27th of February. Among those present were Messrs. C. F. Sise, president, Robert Mackay, vice-president, C. P. Selater, secretary-treasurer, W. R. Driver, Robert Archer, C. R. Hosmer, R. McLean, F. X. St. Charles, J. McRae, J. Wilson, W. B. Miller, T. D. Hood, James Moore, A. Kingman, Reid Taylor, H. A. Budden, Hugh Watson, J. Williamson, D. Ross Ross, W. J. Withall, J. B. McNamee, George H. Holt, Chas. Garth, John Crawford, Andrew Allen, Alex. Paterson, G. M. Kinghorn, Hector MacKenzie and others.

Mr. Selater, the secretary-treasurer, read the annual report as follows:

"The directors beg to submit their sixteenth annual report; 1,028 subscribers have been added during the year, the total number of the sets of instruments now earning rental being 28,809; 45 exchanges and 6 agencies have been constructed and added to the system. The company now owns and operates 345 exchanges and 268 agencies; 522 miles of poles, and 1,700 miles of wire have been added to the long distance system in 1895; of these 100 pole miles and 874 wire miles are in the Ontario department, and 332 pole miles and 913 wire miles are in the Eastern department.

The long distance lines, now owned and operated by the company, comprise 14,851 miles of wire on 5,884 miles of poles, which include a copper metallic circuit line from Montreal to Toronto, constructed during the past year.

Work on the new building in Montreal progressed favorably until it was deemed prudent to discontinue construction during the winter. It will be resumed as early as possible, and we trust that the building will be ready for occupancy before the next annual meeting. The growth of our Winnipeg exchange having rendered the present offices inadequate for the business, it became necessary to secure other quarters, and a lot was purchased on Thistle street, in a favorable location, where a building will be erected during the summer, which will be used solely for the purposes of the company.

The gross revenue for the year was \$1,087,124.28, the expenses were \$787,240.30, the net revenue was \$299,874.92, the paid up capital is \$3,168,000.

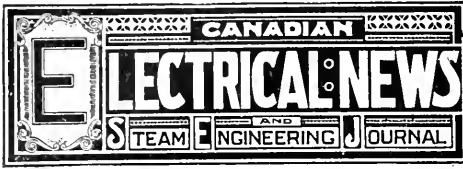
In addition to the net revenue of \$299,874.92, the premium on bonds sold during the year, amounted to \$10,750, making a total of \$310,624.92, out of which \$253,431.33 have been paid in dividends, and the balance of \$57,193.59 together with \$2,800.41, taken from revenue account, has been carried to the contingent account, which now amounts to \$910,000.

In moving the adoption of the report, the chairman made a feeling reference to the loss the company had sustained through the death of the late vice-president, Mr. G. Ross. The report was adopted.

In reply to a question, the president stated that the net revenue of the company for the year had been 10 per cent. The revenue from long distance lines had been, in 1893, \$140,000; 1894, \$152,000; 1895, \$178,213.

The directors were authorized to make a further issue of debentures for \$600,000, in accordance with the authority given by the Dominion statute. These funds are required to meet current expenses entailed in improving the system. This sum will bring the total issue up to \$1,200,000.

The balloting for officers resulted in the old board being re-elected as follows: C. F. Sise, president; Robert Mackay, vice-president; directors, W. H. Forbes, John E. Hudson, Robert Archer, Wm. R. Driver, Hugh Paton and Charles Cassils.



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "*Canadian Electrical News*" has been appointed the official paper of the Canadian Electrical Association.

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CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. W. Lewis, President; S. Thompson, Vice-President; T. Eversfield, Recording Secretary, University Crescent.

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BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Macabach's Hall. E. C. Johnston, President; W. R. Cornish, Vice-Pres.; Wm. Norris, Corresponding Secretary, 211 Wellington street.

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LONDON BRANCH NO. 5.—Meets once a month in the Huron and Erie Loan Savings Co.'s block. Robert Simmie, President; F. Kidner, Vice-President; Wm. Meaden, Secretary Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30 p.m. J. Fordyce, President; J. Tuck, Vice-President; H. T. Flewelling, Rec.-Secretary; J. Verry, Fin.-Secretary; Treasurer, C. J. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; F. Merrill, Secretary, 352 Wellington street.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. W. J. Rhodes, President; G. Steinmetz, Secretary, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King street, at 8 p.m. President, S. Donnelly; Vice-President, Henry Hopkins; Secretary, J. W. Tandvin.

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KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKillop's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Works.

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BROCKVILLE BRANCH NO. 15.—President, W. F. Chapman; Vice-President, A. Franklin; Recording Secretary, Wm. Robinson.

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ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

Modern Central Station Engineering.

THE tendency of modern central station engineering is towards greater science, higher economy, more comprehensive business methods.

In the early history of electric lighting (about five or six years ago) we used to be satisfied —more, we were pleased if on closing the switch we got light in the lamps, and our electricians used to be happy and read the paper while the plant ran itself. The fireman also piled in coal, and on cold nights opened the fire door to warm himself at; and if profits were not very large—well — "Electricity didn't pay anyway." But to-day our electrician has something else to do, and the superintendent can tell by comparing the reading of the station watt-meter with the last night's fuel consumption, how many times the furnace door was opened, and for how long, and if Mr. Fireman has not a satisfactory explanation to give he goes suddenly. In those days we knew how much coal was burnt and how much wages we paid, and if the income from the lamps was sufficiently large to have a little over, after paying expenses, we pocketed it with a thankful heart, and asked no questions. How very different is the method of running a central station now-a-days. In the first place, a comprehensive business policy governs the entire management, and furnishes a framework, into which are fitted such details as differential rental rates, lamp efficiencies, etc. The tabulation and classification of operating statistics will, in the hands of an experienced manager, be not only a sure record of the past, but also a guide to the future, and a careful and observant study of such dry statistics will often serve to so modify the

general policy as to effect considerable improvements in operating methods, or in profits. In the next place, each individual bit of machinery in the system, be it boiler, engine, belt, generator, or lamp socket, is continually under the watchful eye of the observant manager, who knows what it is capable of doing under favorable circumstances, and if at any time it falls somewhat below the mark, he knows it, and must know the reason why. If 500 lbs. of coal are burnt more to-night than last night, he is aware of it next morning, and far from saying it "can't be helped," he finds out why it was—whether there was a greater demand for current by consumers, or whether a belt slipped, or a valve got wrong. It can and must be helped, and is helped. The repair account is scrutinized narrowly every year, and any bit of apparatus that seemed to require frequent attention is examined with the object of making it more durable, and so reducing the expenses. There is a ceaseless effort to so raise the efficiency of the whole system, that the same amount of current may be generated at a less expense; or shall do a greater amount of work and so gain more; and the means to this end are enquiry into every stage in the process of converting coal into current, and ceaseless energy and investigation.

Guarantees. INVESTORS in electrical and steam machinery have an idea that if they base their selection of machinery on the guarantees given by the makers, they cannot go far wrong. When making a choice between several competing proposals, they do not very often take proper means to arrive at which is really the best for their particular case; but place their orders with the maker who gives the best guarantees. Before doing this they should consider first, what are the conditions under which the guarantee is given; and second, what means they have of proving it. Now-a-days that prices are cut so very low owing to the intense competition between all manufacturing companies, it is impossible in many cases for agents to cut still lower in order to obtain business, so their resource is to claim higher value for their goods, and if by guaranteeing a slightly greater efficiency or longer life, etc., they can effect a sale it is a little too much to expect of human nature that an agent will not guarantee a little more than he knows he can perform, when he has very good reason to believe that his machinery will not be put to any test, but that his bare word will suffice. It is perfectly evident that to buy machinery on the unsupported guarantee of an agent, and then not to test it to ensure its meeting such guarantee, is not only very foolish from the purchaser's own standpoint, but it is distinctly unfair to the whole manufacturing interest. It amounts in plain terms to placing a premium on dishonesty, and the purchaser frequently gets as badly let in as he thoroughly deserves to. A thoroughly reputable and honorable business man will make sure of what his goods are worth and will guarantee them for that and no more, relying on such policy to build up a business. A less responsible person will push the sale of his goods by claiming for them a value they may not possess, and take his chances that he may not be found out. Now whether he is found out or not, the purchaser does not see his money's worth, and has actually assisted in rewarding fraud. In the few instances where electrical and steam machinery have been purchased in the open market by competing tenders, any specifications that

have been got out require such and such guarantees to be given of efficiency, etc., and the contracts have frequently been given to those guaranteeing the highest and most. But in how many cases have actual tests been made by competent persons, as to whether these efficiencies, etc., are really as guaranteed? And is it not plain that this system of purchasing on a basis of "competing guarantees" is a very foolish one unless there be some intention of testing their fulfilment?

Guarantees, even the best, may be very misleading unless some understanding be arrived at as to the conditions under which they are given, and a very little consideration will show that persons not specially trained may be completely hoodwinked when they think they are very wide awake. Take the guarantee that is so frequently given with a boiler, that "it will evaporate so many lbs. of water per lb. of coal." This appears very simple no doubt—to compare boilers by this guarantee is as easy as falling off a log. But a boiler does not evaporate water itself; it must be set "just so," and have a certain number of feet of grate surface with a certain amount of draft. And again, "so many lbs. water evaporated per lb. of coal." What kind of coal? All coal is not the same. We have hard coal and soft coal; we have coal containing 13,000 heat units per lb., and we have coal containing only 7,000. Again we ask, what coal? Best Yonghisberry? Any boiler will do that with such superior coal; but it takes a good one to do it with lignite. Briefly, what is such a guarantee worth? Nothing. The person who gives it is in most cases a designing quack, and the purchaser who accepts it is an innocent simpleton. The guarantor gives it because he knows it never will be tested, and if it ever is tested he can say the conditions were not complied with. If persons require guarantees to be given with machinery, they should be satisfied with reasonable ones; they should establish the necessary conditions, and they should insist on tests being made to prove them. In this way, in a very short time, all but the reputable manufacturers will be crowded out of business.

Electrical Engineering as a Profession.

THE question is frequently asked, "In what field of effort may a young man hope to meet with the greatest amount of success in the present day?" Every department appears to be overcrowded, and the problem of the choice of a career is becoming more and more difficult of solution. The rapid development of the past few years in the applications of electricity has turned the attention of parents and young men in this direction, and there appears to be a widespread belief that this is the most promising field of effort for the future. With the view of determining to what extent this belief is well founded, Mr. Henry Floy, in an article in the *Engineering Magazine* for January, entitled "Are we Educating too many Electricians?" gives the result of an extended enquiry among graduates of engineering schools, as to the extent to which students of electricity graduating from these schools have been successful in obtaining employment at remunerative salaries. Referring to the tabulated results of these enquiries, Mr. Floy sums up the subject in the following words: "Considering the table of total results, which may be taken as a fair indication of the condition of the recent graduates in electrical engineering, it will be found that, while a greater

per cent. of the graduates in electrical engineering secure employment, as compared with other graduates, yet the fewest, relatively, secure employment in the line of work for which they had studied, that is, in order to get employment, they had to take positions in which their electrical knowledge did not count. It will furthermore be noticed that almost twice as many men secure employment in electrical engineering through the influence of their relatives as in mechanical or civil engineering, while about half as many obtain positions through their friends as in the other two professions."

Useless Fenders. The fenders on some of the Toronto Railway Company's cars are elevated too far above the track to allow of an obstruction of reasonable size being scooped up by them. An individual who should be so unfortunate as to fall in front of one of these cars would almost certainly pass under the fender and be crushed to death. Fenders attached to cars in this manner are a mockery.

Questions and Answers. By reference to our Question and Answer Department, it will be seen that some of our subscribers appear to have suddenly made the discovery of their privilege to ask questions and receive information through the pages of THE ELECTRICAL NEWS on any problems in electricity or steam engineering with which they may find themselves confronted. This should be gratifying to every reader, as well as to the publisher. The more questions are asked and answered, the more helpful the journal must become to its subscribers, and the greater evidence to the publisher that it is being widely and carefully read—a matter in which advertisers should also feel an interest. We have daily evidence that the NEWS is becoming more widely known and appreciated by the classes in whose interest it is published. There is no occasion for the expressed hesitancy and apologies with which some of the questions received are propounded. Questions honestly propounded, and of a character to draw forth information of a practically useful character, are cordially invited. If we except the man who "knows it all," we are all in the position of the pupil who is daily adding to his stock of knowledge, therefore, we need feel no hesitation about admitting our lack of knowledge on certain subjects, with which, perhaps, we have not had the opportunity to become acquainted. Those who know the most are invariably ready to admit what they don't know, and to ask to be enlightened. There is little hope of improvement for the man who either thinks he knows it all or is ashamed to ask for the information he requires lest he should be thought ignorant. So far as the readers of this journal are concerned, it is only necessary that they should ask in order to receive any information which it is in our power to give.

The Montreal Street Railway Co. have ordered a 55 kilowatt direct connected motor-generator set from the Canadian General Electric Co.

Mr. F. O. Blackwell, of New York, engineer of the General Electric Power Co. was recently in Quebec in connection with the proposed electric street railway. Mr. Blackwell inspected the works and machinery of the Montmorency Electric Light Company. The construction of the railway in accordance with the present agreement, includes the taking over of this plant. It is said to be the intention of the promoters to commence work about the first of April.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

TORONTO NO. 1.

The above Association now hold their meetings in the new hall on Victoria street on the 1st and 3rd Wednesday in each month. The business transacted at their last meeting was largely in connection with the taking over of their new quarters. Arrangements have been made for starting the new library; some donations have already been received, while a number of manufacturing firms have promised books and models which will make the collection very valuable to the members of the Association. A letter containing the following has been sent to probable contributors to the library:

"Toronto No. 1. is now entering upon its tenth year, and having procured a new and suitable hall, propose commemorating the event by starting a mechanical library, and fitting the meeting room up with models and drawings. Should you feel disposed to assist, in any way, this very laudable object, an intimation to any member of the committee to that effect will be thankfully received, and promptly attended to."

An engineers' manual or pocket book is being prepared by the Association, which will consist of valuable tables and calculations relating to steam engineering. It will be compiled from the works of the best authorities, and is intended to supply engineers with easily accessible and correct calculations upon which to work.

A committee has been appointed to act in conjunction with a similar committee from the Ontario Association with a view to secure a compulsory law from the government, for engineers operating steam plants. It is not probable that any action will be taken by the government this session, owing to its close being near at hand. It is hoped that at the next session a bill will be brought in by the government which will ensure its success. The bill, as proposed, will exempt all steam engines under 15 horse power, and all persons running plants at the time will be given a permit, thus retaining their positions. The certificates of the Marine Engineers' Association, and the Ontario Association would also be accepted.

BRANTFORD NO. 4.

Mr. Jos. Ogle, secretary of Brantford No. 4 writes: "We are in a very healthy condition; our meetings are well attended and some very good questions brought forward and practically answered. The debate for our last regular meeting was, "Cylinder Condensation—Illustrations of Indicator Cards," which occupied our time fully to a late hour, having a various number of select cards illustrated on the blackboard."

LONDON NO. 5.

London No. 5 has not been meeting with much success since the opening of the new year. From lack of attendance meetings have not been held, and the members have shown some indifference towards the Association. It is the hope of the officers that a revival in interest will be shown henceforth, in order that the association may not be allowed to become extinct.

GUELPH NO. 6.

The above Association held meetings on the first and third Wednesdays of February. There was a good attendance at each meeting, and one candidate initiated at the first meeting. On the 20th inst. Messrs. Ryan and Gerry read papers on the care of boilers and the keeping of the engine room.

CARLETON PLACE, NO. 16.

J. D. Armstrong, Secretary, writes: "Branch No. 16 has not been in a very prosperous state for the past year but has been reorganized, and is now in a far better shape than ever. Although our numbers are small, we are enthusiastic and look forward at an early date to forming the nucleus of a library, also to invest in some models. We have rooms over our President's place of business, and we may say that for the first time in our existence we are now on the way to becoming a successful society. We meet during March and April every Saturday night, and questions are given the members who purpose trying for certificates, to be answered the following week, so that if they get a certificate they will have to work for it.

A MOTOR-CYCLE CONTEST IN CANADA.

THE letter published in our February number from the pen of Mr. A. W. White, of London, Ont., relative to a contest of motor-cycles in Canada, has been the means of creating considerable interest in the matter. No action has as yet been taken by the Industrial Exhibition Association, but it is learned from the manager that it is quite probable that a contest will be arranged to take place during the coming exhibition. The test would take place on the public highway, a part of the agreement being that the contestants should exhibit their vehicles in the ring on certain days.

As to the conditions under which the contest should be conducted, we have received the following suggestions:

Mr. G. H. Hewitt, President Duryea Motor Wagon Company, Springfield, Mass.: The "Cosmopolitan" offers prizes for a competition in which the awards are made upon points, such as speed, simplicity, durability of construction, cost, safety, etc. To my mind it would be manifestly absurd to award the first prize to the carriage which should come in last, even if it stood all



THE DURYEA MOTOR CARRIAGE.

the other tests. Either you must go into an exhaustive examination of each carriage or you must cut off all examination and let speed over a certain number of miles of ordinary road determine the merit. I am inclined to take up the idea of three trials and taking an average as the result. As to the amount of prize money, of course the more it is the more of an inducement it will be for people who are working on new designs to compete. A chance of getting a big prize will cause a man to hurry up his ideas, and enlist capital on his account. I presume you can get a good showing for \$3,000 in prizes, say: First prize \$1,500; second prize \$1,000; third prize \$500. We should be happy to enter, if the rules are satisfactory.

Morris & Salom, Philadelphia, Pa.: The only suggestions that we have to make in regard to the conditions governing the race is that the trial should be based on a service similar to that performed by horses at the present time. There is nothing to be gained by a run of 100 miles or more, which is merely a tour de force. Some tests should be selected under the conditions governing the use of horses at the present time, and they should be continued from day to day so that a comparison can be made with such service. The ordinary service of a horse does not amount to more than 25 miles per day, and as motor vehicles are intended to replace horses this point should be carefully kept in view in making comparative tests.

H. Mueller Mfg. Co., Decatur, Ill.: We think it advisable to make a maximum speed, say twelve miles per hour, those making a faster average speed being considered the same. This would be quite fast enough, as what we want is a practical carriage—one for general use, not for racing; one that will go at a good speed, have a strong pull at that speed, and be able to continue the same speed throughout, taking into consideration the kind of roads. Then economy of operation is the next factor to consider, because the better the economy the more practical the motor, and, besides, it would be a very easy matter to construct a powerful motor when the economy of fuel was left out of consideration. Simplicity and compactness should be considered together, as the motor might be compact, but be so intricate that in order to repair a certain part it would necessitate much unnecessary work to arrive at the fractured part, which might be the same with adjustment. Then, again, a motor might be simple in all of its parts, but not compact. It would occupy too much consideration to mention in detail all concerning the different subjects to consider, but those mentioned we consider first, besides there being vibration, odor, ease of guiding, controlling of speed, variation, quick stopping, etc. Why not make awards on the following principle: Say you call speed 40 points, economy 20 points, etc., making the total number of points that each motor vehicle can receive 100 points. Now, say Mr. A. comes in first, you give him 40 points in speed, you award him second in economy, which we will call 15 points, and then 5 points in simplicity and compactness, 2 points in elegance of design, 2 points in guiding, 2 points in controlling of speed, and perhaps nothing in remaining features. Now, Mr. B. comes in second, and you give him 35 points in speed, economy 20, simplicity 10, elegance of design 5, guiding 5, quick stop and start 4, vibration 3, odor 3, the total of which is 85 points, whereas Mr. A.'s total was 66 points, which would allow Mr. B. first prize for the most practical carriage.

TRADE NOTES.

Messrs. Rhodes, Curry & Co. have completed fourteen closed cars for the Halifax street railway.

J. G. Field, of Tavistock, Ont., has purchased an alternating plant from the Canadian General Electric Co.

The Acadia Sugar Refining Co., Ltd., has ordered two 60 horse power Robb-Armstrong engines, for the Woodside and Nova Scotia Refineries.

The Berlin and Waterloo Street Railway Company have placed an order for additional G. E. 800 motors with the Canadian General Electric Co.

The Petrolia Light, Heat and Power Co. have recently put in a complete condensing plant, including a Goldie & McCulloch 125 h. p. boiler and a Northey condenser.

The Halifax Illuminating Co. are now installing the first of their 150 kilowatt monocyelic alternators recently ordered from the Canadian General Electric Co.

The Standard Shirt Co., of Montreal, have purchased a 100 h. p. Wheelock engine with which to operate electric motors in the several departments of their factory.

The Royal Electric Co. have rented the vacant store on the south of their premises on York street, Toronto, and by removing the partition wall, have doubled their office and show-room accommodation, besides adding greatly to the attractiveness of their establishment.

The Penberthy Injector Co., of Detroit, Mich., and Windsor, Ont., have lately issued an attractive catalogue relating to their celebrated injectors and other steam users' supplies. This catalogue contains much valuable information in the way of tables of capacities and results, directions for determining size of injector required, etc.

The Goldie & McCulloch Co., of Galt, Ont., have recently secured the right to manufacture for Canada the Ideal Automatic Self-oiling high speed engine. This engine is especially adapted to direct connected work, such as the operation of electric machinery. We hope to be able to publish further details of this engine at an early day.

THE STEAM ENGINE INDICATOR AND ITS USES.

BY WM. THOMPSON, CHIEF ENGINEER MONTREAL WEST WATER AND LIGHT STATION.

(Continued from January Number)

It will be found an exceedingly interesting and useful study to compare and test the expansion curve drawn by the indicator with the theoretical curve that would be drawn if the steam was a perfect gas and expanding in accordance with Mariotte's laws for the expansion and contraction of perfect gases, i.e., that the pressure of steam expanded will be inversely proportional to the space it occupies. Thus, if one cubic foot of steam at 80 lbs. pressure is expanded to 2 cubic feet, or twice the space, then the pressure will fall to 40 lbs., or exactly half its original pressure, owing to the space it occupied at 80 lbs. pressure having been doubled. The pressure will thus fall proportionately to meet all other degrees of expansion.

The engineer must, however, bear in mind that these pressures must be dealt with as total or absolute pressures, that is, reckoned from a perfect vacuum, and also that the clearance space must be carefully noted, and a line drawn on diagram representing an amount of space on diagram equal to same per cent. of space that total area of clearance space bears to piston displacement. This is made evident by the fact that when cut-off takes place piston will only have moved a given distance or part of stroke, and that, supposing cut-off to occur at $\frac{1}{4}$ stroke, then to get correct space occupied by steam at any pressure at any point of stroke, clearance space at end of stroke, together with area of steam passages must be taken into consideration, as all steam confined and bearing on piston must have an effect on expansion curve, and when piston reaches $\frac{1}{2}$ stroke, space occupied by steam would not be fairly represented by supposing space to have been doubled while area through which piston has moved would be exactly doubled. Clearance line on diagram will vary as to position with different makes of engines, and can only be correctly ascertained by measuring engine on which test is being made. While steam confined in clearance space does no actual work during live steam period, just as soon as cut-off takes place it has an effect on expansion curve and raises terminal pressure as compared with steam expanded from the admission line only.

The engineer will note that any irregularity or bad arrangement of valves can be readily detected by the position of the various lines, while defects, such as leaky valves or piston, can only be

phic line upon it as already described, and from this as a basis draw in the line of no pressure or line of perfect vacuum. To do this, draw beneath the atmospheric line a line as far beneath it as will represent the vacuum line on the same scale as the spring used in the indicator to draw the diagram. The clearance line must then be drawn in accordance with rules already given. Divide the length of the diagram into any number of equal parts by vertical lines at right angles to the atmospheric line and commencing at the clearance line as shown in Fig. 1.

Number the vertical lines as shown—to be used in this instance simply because it is a convenient number, but any number would do; the more lines used the greater the degree of accuracy obtained.

Decide which part of the diagram its expansion curve shall coincide with, and touch the test curve; in example I have decided it shall be line No. 9. Now find what pressure line 9 represents on the scale of the indicator spring—which in this case is 29 lbs.—the line measuring $\frac{29}{40}$ of an inch and a 40 lb. spring having been used to draw the diagram. Next multiply the pressure thus obtained by the number of the line (9) and divide the product by the number of each of the other lines in succession, and quotient will in each case be the pressures to be represented by the lines.

For example, to find the pressure requiring to be shown on line

Inches	Volume	Eff.
.87	270	100
.98	305	88
1.14	353	75
1.34	417	63
1.64	509	51
2.12	655	39
3"	926	27

Fig. 2

8, we have that, (261) divided by number of line (8) gives 32.6—hence line 8 requires to be drawn high enough to represent a pressure of 32.6 lbs. above a perfect vacuum, or in this case 32.6/40 of an inch. Having carried this out for all the lines from 10—2, draw in the test curve, which will touch the tops of all these lines.

This curve, however, does not quite correctly represent the expansion of steam, although generally used. It would do so if the steam remained or was maintained at a uniform temperature during the whole period of expansion. It is therefore called the isothermal curve or curve of equal temperature. But, in fact, steam and all other elastic fluids fall in temperature during expansion and rise during compression, this change of temperature slightly changing and affecting the pressure.

A curve in which the combined effects of volume and resulting temperatures is represented is called the adiabatic curve or curve of no transmission since no heat is transmitted to or from the fluid during the change of volume, its sensible temperature will change according to a fixed ratio which will be the same for the same fluid in all cases.

A fairly close approximation to the adiabatic curve, to enable the engineer to form an idea of the difference between the two may be produced by the following process.

Take a diagram similar to the one used in Fig. 1 and illustrated as Fig. 2. Fix on a point for the coincidence of the two lines as before as at A, where the total pressure is shown to be 27 lbs. As in the former instance this point is chosen in order that the curves will coincide. Any other point might have been chosen for the point of contact; but a point in that vicinity should gener-

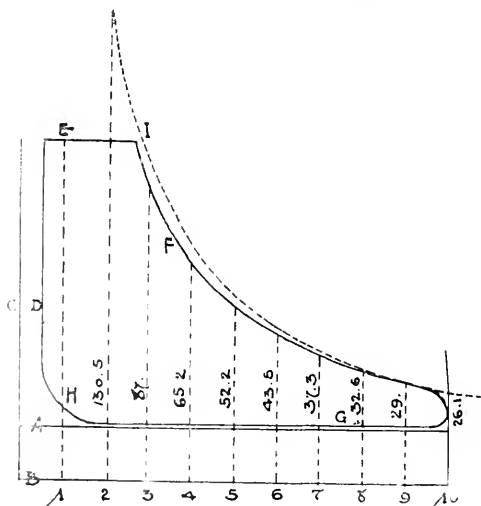


Fig. 1

A, Atmospheric Line; B, Vacuum Line; C, Clearance Line; D, Admission Line; E, Steam Line; F, Expansion Curve; G, Exhaust Line; H, Compression Curve; I, Isothermal Curve (Test).

detected by testing and comparing expansion curve, particularly if leak is a small one.

A theoretical expansion curve to conform with above theory may be constructed by several geometrical methods, but probably the following will be the most easily understood by the average engineer:—

The diagram as drawn by the indicator will have the atmos-

ally be chosen so that the result will show the amount of power that should be obtained from existing terminals.

The point chosen in Fig. 2 is 3 inches from the clearance line, and the volume of 27 lbs. is 926—that is, steam of that pressure has 926 times the bulk of water from which it was evaporated.

If we divide the distance of A from the clearance line by .926 and multiply the quotient by each of the volumes of the other pressures indicated by similar lines, the products will be the respective lengths of the lines measured from the clearance line—the desired curve passing and touching their extreme ends. Thus, the quotient of the first or 27 lbs. pressure line, divided by its volume (.926) is .00323. This, multiplied by 635, the volume of the next pressure line (39.) gives 2.12 inches, the length of the line to be drawn from the clearance line, and so on for all the rest throughout the illustration.

The application of either of the above curves will show that some diagrams are much more accurate than others. As a general rule those from large sized engines will be more correct than from small ones, and those from high more correct than from low speeds, and with efficiently covered steam pipes and jacketed cylinders to prevent condensation, a great improvement can be effected.

The character of the imperfections in the expansion curve in the illustration (Fig. 1) shown by the application of the test curve is too high a terminal pressure for the point of cut-off—the first part of the curve being fairly correct, nearly the whole of the inaccuracy occurring during the last half. The usual and most accepted explanation of this is, that the steam admitted during the live steam period condenses somewhat, owing to its having to impart a certain amount of heat to the walls of the cylinder to raise it from the temperature retained from the exhaust steam, and that this water of condensation re-evaporates during the latter part of the stroke, when this water of condensation is at a higher temperature than the expanded steam, and thus increases the pressure. A leaky admission valve or wet steam may, however, generally be looked for if the expansion curve rises much during the latter part of stroke.

In seeking the causes that may produce a defective diagram, the following should be remembered : The indicator must be kept in perfect order, thoroughly clean and well lubricated, so that its parts will move freely. The motion of the paper drum should record an exact copy on a reduced scale of the piston, and should coincide with it at every point of the stroke.

The pipes from the indicator to the cylinder must be large enough to give a free and full admission and pressure of steam, and care must be taken that the water of condensation does not obstruct or enter the indicator.

The metallic point or pencil should be held to the card with just sufficient force to make a fine clear line.

The diagram should be the exact length of the atmospheric line; any difference in this respect shows poor adjustment in some part or unequal tension of cord.

A fall in the steam line could arise from too small a steam pipe. This can be tested by taking a diagram from the steam chest. The same fault could also occur from too small a steam port or an obstructed passage, such as partial closing of admission valve, also by steam leaking past piston and passing to atmosphere unutilized.

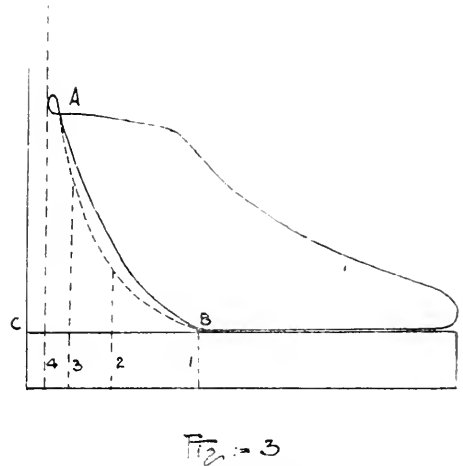
An expansion curve that is higher than it should be could arise from a leaky valve on the steam side letting steam in from the steam chest after cut-off had taken place; in this case the leak will naturally become larger as the steam expands and pressure on piston side of valve reduces, consequently terminal pressure will be more or less out of proportion.

An expansion curve that is lower than it should be may be caused by a leaky piston, by a valve that leaks on the exhaust side, but not on the steam side; or if the exhaust valve is separate from the admission valve, it may leak while the steam valve is tight, thus lowering the terminal pressure. It may also be caused by the cylinder becoming unduly cooled, as from water being allowed to accumulate in a steam jacket; this will particularly affect the curve during the earliest stages of expansion or even during admission.

As already explained there are many defects in the adjustment of the valve gear that will be clearly shown by the indicator diagram. But, it should be borne in mind that there are possible defects which the indicator will not show. For instance, a steam valve and the engine piston may both leak to an equal amount; as a result the expansion curve may not show the leak, while, as a matter of fact, loss is occurring from this source.

Insufficient valve lead, or in other words the admission valve opening too slow or late, would be shown by the piston moving a certain portion of the stroke before the steam line attained its greatest height. In this case the admission line, instead of rising vertically as shown in illustrations, would be at an angle to the right showing that the piston and consequently the indicator drum had moved a certain distance of the stroke before the valve was wide open and full pressure of steam admitted.

Exclusive lead is shown in Fig. 3 by the loop at A, where the compression curve extends up to the steam line and the lead carries the admission line above it owing to the engine piston moving against the incoming steam.



To mark in the theoretical compression curve, that is the curve that would be formed by the compression of the steam remaining in the cylinder after the exhaust valve had closed and previous to the opening of the admission valve, the vacuum line and clearance line must be drawn in as before. In Fig. 3 compression commences at B, and at that time the space filled with steam is represented by the distance from B to the clearance line C'. The pressure above vacuum of the steam remaining in the cylinder when compression began is shown by dotted line. Suppose the piston to have moved from point B to line 2, which is half the distance from the clearance line, of line 1, and as the compressed steam now occupies only one-half its former space, therefore the steam pressure will be doubled and line 2 requires to be drawn twice the length of line 1.

Line 2 is now the starting point for getting the next ordinate and 3 must be marked midway between 2 and the clearance line and twice as high as line 2, as it is obvious that at line 3 the steam will occupy only half the space it did at 2 and one-quarter of the space at 1, hence pressure is increased proportionately. Line 4 is drawn midway between 3 and the clearance line as before. Through the tops of these lines draw the theoretical compression curve as shown by the dotted line.

To find amount of steam actually saved by compression, consider the compression curve only beginning at the point of the diagram where compression actually began, and ending where the compression curve joins the admission line, the horizontal distance between these two representing the length of the cylinder bore actually filled by compressed steam.

It is stated that in a few weeks the Edison Electric Illuminating Company of New York will have in operation at one of their stations two 300 h.p. De Laval steam turbines with attached dynamos. These turbines were built by the Maison Breguet, Paris, and are now on their way to America. They were ordered under guarantee to comply with the following specifications: each 300 h.p. turbine is to drive two Desroziers dynamos, each of 133 h.p. capacity. The turbine shaft is to run at 13,000 revolutions, driving at a speed of 1,300 revolutions by means of helical gearing, two dynamo shafts situated on either side of the turbine shaft. Each dynamo is to be capable of generating continuously without undue heating 770 amperes at 130 volts or 625 amperes at 160 volts.

ELECTRICAL DEVELOPMENTS AT MONTREAL.

THE electric light situation in Montreal, as well as in Toronto, is at present at an interesting stage. The company formed some time ago, for the purpose of utilizing the water power of the Lachine Rapids, have been energetically pushing forward their enterprise, and maturing plans for the disposal of the electrical energy which will be generated from the works now in process of construction at Lachine.

It is understood that the company have bought up the lighting privileges of Westmount and several of the other suburban municipalities of Montreal, as well as the franchise of the Standard Electric Lighting Co., which is said to carry with it the right to do electric lighting within the city of Montreal. Under this latter franchise, the company propose to compete for the lighting and power business of the city of Montreal. They have already constructed poles and wires to a point about a mile within the city limits, but here their operations have had to be suspended for a time at least, owing to legal action brought against them by the Royal Electric Co.

The Royal Company, it is understood, will endeavor to prove that the franchise under which the company are proceeding, does not give them the right to do business inside the city, and the courts are now considering an application for an injunction to restrain the new company from proceeding further with their enterprise so far as city business is concerned.

It is claimed that the Lachine Power Co. will be in a position to supply current at a greatly reduced rate as compared with the prices that are now being charged for lighting and power in the city of Montreal.

It will be remembered that several years ago the Royal Electric Co. purchased the water power at Chambly, across the river from Montreal, and about six miles distant from the city. The intention of the company seemed then to be to utilize as quickly as possible this water power. It is therefore somewhat surprising that nothing has been done in this direction, while a competitor has in the meantime secured the control of a greater water power, and one which is more conveniently situated. No doubt the fact that the Royal Company would have been obliged to bring the current across the St. Lawrence, through a sub-marine cable, which would be subject to the destroying action of frost and ice, at a point where an ice jam is a yearly occurrence, had something to do with the fact that no attempt has been made to utilize the power from this source. On the other hand the company are understood to be remodelling from top to bottom their electric lighting station, thus putting themselves in a position to meet any competition which may arise.

The following particulars of the works now in course of construction at the Lachine Rapids, under the direction of Mr. W. McLea Walbank, C. E., and R. E. T. Pringle, M. E., by Messrs. Davis & Sons, contractors, of Ottawa, with the aid of 300 workmen, will show the magnitude of the undertaking:—

Along the north shore of the river within 1,000 feet of it, 2,500 soundings have been made, which have shown that to overcome the freezing of the shallow water 250,000 cubic yards of shale rock will have to be taken out to deepen the water. When this is done an artificial canal will be made by building a wall 4,500 feet long and 20 feet wide, 800 feet from shore. 3,000 feet of this wall is to be built of crib work, filled with masonry and concrete, the rest of the wall, 1,500 feet, at the head of the head race, is to be submerged, coming within a foot of the surface of the water and built of cut stone to act as an ice breaker. Across the canal is being built a dam to raise the water $9\frac{1}{2}$ feet above the tail race, the canal wall being at its highest to keep floating objects from the wheels.

In this dam are to be placed 66 upright cylindrical gate turbine wheels to give 125 h. p. under 8 feet head, to realize 80% useful effect. Each wheel is placed between two stone piers. On this dam will be built three power houses, connected by galvanized iron sheds, the sheds covering the wheels. Each generator will be of

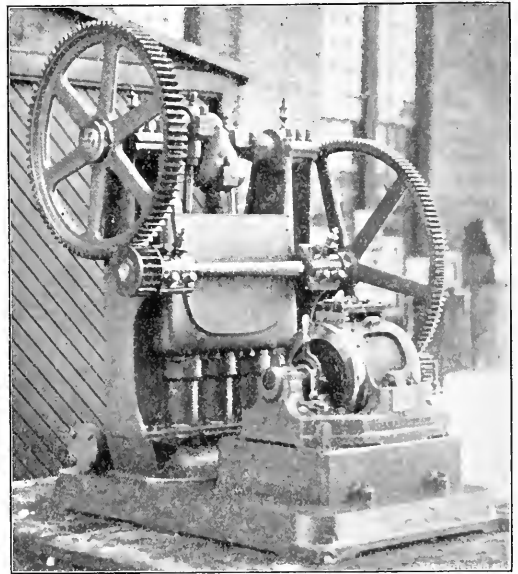
the capacity of 750 h. p., having connected to it six wheels. Each power house will contain four such generators. All the generators will be connected to one switch-board, and the power will be carried under high voltage to Montreal, where by rotary transformers it will be reduced to the required voltage for power by day and power and light at night. The plant is to be completed and in full running order before the close of the present year.

The provisional board of directors of the company are as follows: G. B. Burland, Montreal and Ottawa; W. McLea Walbank, C. E., Montreal; Thos. Pringle, M. E., Montreal; Alderman Peter Lyall, contractor, Montreal; Samuel Carsley, merchant, Montreal; E. Kirk Green, merchant, Montreal; Hugh Graham, of the "Star," Montreal.

The capital of the company has been placed at \$1,000,000, \$500,000 of which is for sale. Debentures will be issued at 4½%.

DIRECT CONNECTED PUMPING SET.

AN interesting example of the prompt application for the alternating motor in directions which have not up to the present afforded much field for electric power service is presented by the pumping set illustrated herewith, which has recently been installed by the Mattawa Electric Light & Power Company, at Mattawa, Ont. This unit which presents the double advantage for the service of being particularly compact and so simple in operation as to require no attendance whatever, consists of a 5 horse power Canadian General Electric induction



DIRECT CONNECTED PUMPING SET.

motor geared to a Gould triplex pump, current for the motor being obtained from the Mattawa Company's monocyelic circuit. The work to be done is the filling of the C. P. R. water tank, capacity 50,000 gallons, formerly supplied by a steam pumping outfit, the length of the pipe (4") being 2,129 feet, and the lift from the water to top of tank being 96 feet. The motor pumping set has now been in operation for several weeks and has given the most perfect satisfaction. The only attention required at present is to start and stop the motor, but it is intended to do away with the necessity for even this small amount of attendance by having the motor started and stopped by the operation of a float in the tank.

The enterprise of the Mattawa Electric Light and Power Company in opening up what we believe to be an entirely new field for electric power, will, no doubt, be followed by other and older stations.

THE APPLICATION OF OHM'S LAW.*

By W. NORRIS.

It has become necessary for engineers to have a knowledge of electricity and the application of the same. I am therefore prompted to take a step towards making that subject to have a more prominent place in the engineers' lodge room. It is with much pleasure that I will try to illustrate a few important points that will be of much use to beginners.

Whenever we require to make any calculations upon the current that will flow from any kind of electrical supply through an ordinary conductor, we must have some law by which to be guided. Professor Ohm has laid down a law which is known as Ohm's Law, and reads as follows:

$$\text{Current in Amperes} = \frac{\text{Electrical motive force in volts.}}{\text{Resistance in ohms.}}$$

For instance, one volt will force one ampere through a resistance of one ohm.

100 feet of No. 10 B. & S. copper wire, which will conduct about 98 per cent. of the current, has a resistance of one ohm. So if the current in amperes is equal to the electromotive force divided by the resistance in ohms, then the resistance in ohms will be equal to the electromotive force divided by the current in amperes, and the electromotive force will be equal to the current in amperes multiplied by the resistance in ohms, and is represented in the following manner:

$$C = \frac{E}{R}, \quad R = \frac{E}{C}, \quad E = C \times R.$$

It can be plainly seen that if any two of the above elements are known, it is an easy matter to find the remaining one.

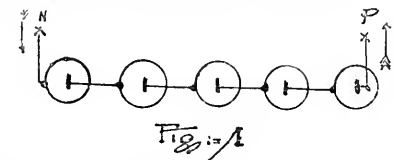
The figures 2, 8, and 4 always stand for C, E, and R, respectively. In order to illustrate the use of Ohm's law more plainly, we will suppose we have a simple primary cell of battery with an E. M. F. of 2 volts, leaving a resistance within itself of $\frac{1}{2}$ ohm; then, according to the formula $C = \frac{E}{R}$, we have 2 volts divided by $\frac{1}{2}$ an ohm, equals 4 amperes, thus:

$$5 \text{ ohms} \times 2.0 \text{ V} = 4 \text{ A.}$$

If we had found that we had 4 amperes of current and 2 volts pressure, we would have had 2 volts divided by 4 amperes, equals $\frac{1}{2}$ ohm resistance

$$4 \times \frac{2.0}{5} \text{ or } R = \frac{E}{C}$$

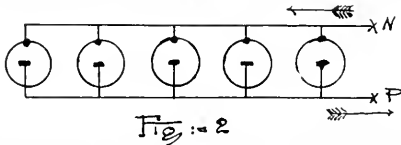
Let us now form a number of these cells together, thus forming a battery. Say we use 5 cells and connect them in series as shown in Fig. 1. By this means we get the effect of all the cells



together, for the voltage will build up according to the number of cells; there are 5 cells in series, although the amperage remains the same as in one cell, because each cell has a definite and determined resistance which increases as there are cells in series, and will only permit the same amount of current to pass through it as it will deliver itself. But each adjoining cell helps to build up voltage; therefore we have a pressure of 10 volts and 4 amperes from this battery.

One ampere flowing under a pressure of one volt is equal to one watt, which is the mechanical work performed and is the unit of a horse power; for 1,000 Watts constantly delivered to an electric motor will make it deliver one horse power, and as we have 10 volts, then the 10 volts multiplied by 4 amperes equals 40 watts, indicating the amount of work this battery will perform.

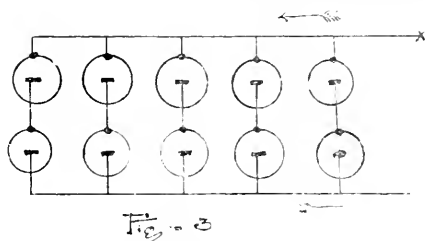
Let us now connect these 5 cells in another manner, as shown in Fig. 2. With all the positive poles connected together and all



the negative poles connected together, this is known as the multiple connection, which causes the battery to deliver the current just the opposite to the series connection. For, instead of the voltage increasing it remains the same as in one cell, while the amperage builds up in proportion to the number of cells in multiple. We have these 5 cells each delivering 4 amperes, and the voltage on the mains is but 2; then 4 amperes multiplied by 5 cells equals 20 amperes, and 20 amperes multiplied by 2 volts equals 40 watts; so it will be plainly seen that the work performed by these two batteries, Nos. 1 and 2, is just the same, although the current is different.

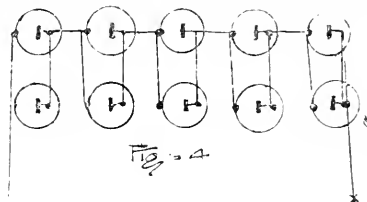
We will now take the same two batteries and connect them both together, making a compound connection as shown in Fig. 3, which is known as the multiple series; for each pair of cells is connected in series, with their positive poles of each pair connect-

ed to one wire, and all the negative poles likewise, so that from each pair of cells in series we have 4 amperes and 4 volts, and as there are 5 pairs of cells in the battery, we have 4 amperes multiplied by 5 pairs of cells, which gives us 20 amperes, which,



multiplied by 4 volts equals 80 watts, showing that the mechanical work that this battery will perform is equal to both the first batteries.

We will take still another form of battery, known as the series multiple, as shown in Fig. 4, using the same number of cells as in



the last battery, each pair of cells being in multiple, thus acting as one large cell, so we would have the same as 5 large cells in the battery placed in series to each other. In this case we would have the same number of volts from each pair as from one small cell, but twice the number of amperes, which would be 8; and as each pair of cells are in series, we would have two volts multiplied by 5, equals 10 volts, because when each pair of cells are in series with each other, the voltage increases, but the amperage remains the same as if there was only one cell. Then by multiplying the 10 volts by the 8 amperes we have $10 \times 8 = 80$ watts, showing that the mechanical work which this battery is able to perform is the same as with the last form of battery, the series multiple, although the voltage and amperage were both different.

Quite a number of other connections can be made to suit the work the battery is required to perform. For instance, we have 5 cells each delivering 2 amperes and 2 volts, and when connected in series would be equal to 10 volts and two amperes, and as the resistance in ohms is equal to the E. M. F. \div by current in amperes, or $R = \frac{E}{C}$, then $10 \div 2 = 5$ ohms which would be the resistance of the battery itself and the resistance in the line wire and bell, etc., should be about the same. So in this case the current in amperes would be equal to the electromotive force divided by the resistance of the battery and line wire, etc., added together, or $C = \frac{E}{R + R'}$, thus $10 \div 10 = 1$ ampere.

Now, the watt is the unit of a horse power of the work performed, and the current in amperes multiplied by the electromotive force equals the number of watts; then $C \times E = W$, $R = \frac{W}{C}$ and $C = \frac{W}{E}$. Supposing we have a 16 candle power lamp taking 3.1 watts per c.p., with 100 volts, how would we find the amperage as well as the resistance of the lamp? The lamp is 16 c.p., watts 3.1 per c.p., then $16 \times 3.1 = 49.6$, or say 50 watts and the current in amperes is equal to the watts divided by the electromotive force, or $C = \frac{W}{E}$. It would therefore be 50 watts divided by 100 volts = $\frac{1}{2}$ as the amperage of the lamp, and the resistance being equal to the electromotive force divided by the current in amperes, it would be 100 volts divided by $\frac{1}{2}$ ampere = 200 ohms as the resistance of the lamp, thus:

$$\therefore \frac{100 \text{ V} \times 2 \text{ A}}{100 \text{ V}} = 2 \text{ ohms.}$$

So the $C = \frac{E}{R}$ because $100 \div 200 = \frac{1}{2}$ ampere, and $C \times E = W$ because $\frac{1}{2}$ ampere \times by 100 volts equals 50 watts.

Nature states that an ingenious system of purifying atmosphere and regulating temperature is in operation for the switchboard room of the Chicago Telephone Company, where dust formerly interfered seriously with the connections on the switchboard. The air for the room is forced through a chamber, where it is thoroughly sprayed, then passed through rapidly rotating spiral coils, which strip it of superfluous moisture, and afterwards through a chamber kept at nearly uniform temperature by the use of ice or heating apparatus, as may be required. Access to the switchboard room is through an ante-chamber, and the temperature of the room itself shows a variation of not more than two degrees in a month.

*Paper read at regular meeting of Hamilton No. 2, C. A. S. E.

ELECTRIC RAILWAY DEPARTMENT.

THE BERLIN AND WATERLOO ELECTRIC RAILWAY.

This road, which last year was electrically equipped, has recently undergone a change of ownership. The controlling interest has passed from the hands of Mrs. Burt, of New York, to Messrs. W. H. and E. C. Breithaupt, of Berlin. Mr. T. M. Burt and Mr. T. E. McLellan will be retained in their present positions in the management, though Mr. E. Carl Breithaupt is the President of the Company with general oversight. The following are the directors: T. M. Burt, T. E. McLellan, A. Millar, G. Bruce and E. C. Breithaupt.

The charter of the Grand Valley Railway, of which E. C. Breithaupt is President, is virtually held by the same parties who now own the Berlin and Waterloo road. They therefore have a strong interest in bringing that scheme into life.

Mr. E. C. Breithaupt, the new President of the Berlin and Waterloo road, is recognized as being one of the most thoroughly educated electricians in Canada. This fact, together with his financial interest in the enterprise, is a guarantee that the road will be equipped and operated in the most approved manner.

SPARKS.

Seventeen open motor cars are now in course of construction for the Toronto Street Railway Company.

Contracts are now being let for the construction of an additional mile of the Guelph Electric railway, which will be completed by the 24th of May.

A Campbellford capitalist is investigating the prospects for the successful operation of an electric railway from Campbellford to Norwood, Ont.

The Ottawa Electric Railway will this summer be extended to Britannia. The route has been surveyed, and the line will be in operation by the 1st of July.

The town council of Perth, Ontario, will be asked to grant a bonus of \$5,000 towards the proposed electric railway between Perth and Lanark.

The plant and charter of the Victoria Electric Railway and Light Co., Victoria, B.C., will be offered for sale by public auction in that city on the 11th of April.

The Railway Committee of the Dominion Government have passed a bill to incorporate the Huron & Ontario Railway Company, which proposes to build an electric railway.

The management of the Hamilton and Dundas Railway Company will shortly submit a proposition to the city council of Hamilton for the conversion of the road into an electric line.

The Port Dalhousie, St. Catharines and Thorold Electric Railway Co. has decided to build eight miles of overhead construction and two miles of track as soon as the weather will permit in the spring.

The Cornwall Street Railway Company, Cornwall, Ont., are applying for incorporation, with a capital stock of \$150,000, to operate an electric street railway in that town and to distribute electricity.

The construction of an electric railway between Parry Sound and Ahmic Harbor, Ont., is one of the probabilities of the near future. The distance is thirty miles and the cost of construction is placed at \$150,000.

Mr. W. S. Adams proposes to build an electric railway from Derwin, on the C.P.R., to Winnipeg river, a distance of twelve miles. The water power on the river will be utilized for supplying electricity for the line.

At the annual meeting of the Hamilton Street Railway Company the following directors were elected: B. E. Charlton (president), Geo. E. Tuckett, E. Martin, Q.C., W. Gibson, M.P., J. B. Griffith, William Harris and F. W. Fearman.

The town council of Lachine, Que., has adopted a by-law granting the Montreal Park & Island Railway running privileges in the town, with exemption from taxation, for thirty years. It is contemplated to build this line this spring, and to extend the Outremont line to St. Laurent.

By the agreement entered between the town of Brockville and the electric street railway company, the company is to have a twenty years' franchise, and is authorized to construct a single track iron street railway. Construction must be commenced before October 7 next, and one mile completed within a year from that date.

The new Board of Directors of the Hamilton Radial Railway Co. is as follows: Rev. Dr. Burns, president; A. McKay, M.P., vice-president; J. D. Andrews, secretary; W. G. Lumsden, treasurer. James Masson, M.P., Owen Sound; F. A. Carpenter, A. H. McKeown, E. P. Powell, London, Ont.; J. F. Smith, Thos. Ramsay and R. McKay.

A report has been current that the Hamilton Street Railway Company will make application to have the percentage of gross earnings of the system which is paid to the city remitted, owing to a large reduction in dividends. The increase in business anticipated as a result of the conversion of the line into an electric road has only partially materialized.

The city council of New Westminster, B.C., has received a communication from Mr. J. Buntzen, secretary of the Consolidated Railway and Light Co., offering to build an electric railway from Westminster to Steveston, with a branch to Sapperton, and to locate the central offices and repair shops in New Westminster. A bonus of \$50,000 is asked from the city.

Albert Phenis, of New York; Lucius S. Oille, M.D., George E. Patterson, J. S. Campbell, of St. Catharines, and Henry A. King, Toronto, have petitioned for a bill to incorporate the Lincoln Radial Electric Railway Company, with power to take over the powers of the Lincoln Street Railway and Traction Company, and to extend the line to Toronto.

Mr. T. W. Lester, president of the Hamilton, Grimsby and Beamsville Railway, states that, notwithstanding the opposition of the Grimsby Council to granting right of way to Beamsville on reasonable terms, the electric road will be extended to Grimsby Park by a new route, independent of the Grimsby Council, and cars will probably be running by 1st July next.

The electric street railway was started in the city of Halifax about the middle of February. The initial trip proved quite successful, and was taken charge of by Mr. Norman Ross, E.E., representing the Canadian General Electric Co. The cars are equipped with C.G.E. 800 motors and parallel controllers. The Train company is installing two large C.G.E. dynamos of monocylic type, having a combined capacity of 6,000 lights. The generators are operated by a 300 h.p. Robb-Armstrong compound engine.

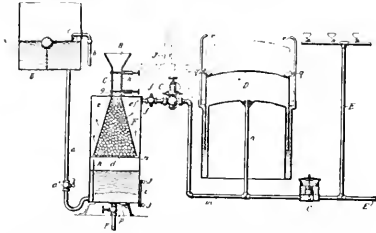
The bill to incorporate the Canadian Electric Railway and Power Company, which proposes to build an electric line from Windsor to Montreal, with branches of not more than 25 miles radius, came before the Railway Committee of the Dominion Parliament on the 26th of February. The promoters are Messrs. Castle Smith, London, Eng.; J. K. Osborne, T. M. Jones, C. W. Beadmore, W. H. Cawthra and Edmund Bristol, of Toronto, and E. F. Fauquier, of Ottawa. The application was opposed by the Grand Trunk and C.P.R. authorities. The measure was allowed to stand over for further consideration.

The supper recently tendered to the employees of the London Street Railway by the efficient manager, Mr. C. E. A. Carr, was one which will be remembered with pleasure by those present. The gathering numbered about 85, and included the office staff, motormen, conductors, power house employees and superintendents. The manager sat at the head of the table, accompanied by Mrs. Carr. The spread was an excellent one, and after full justice had been done, a toast list was introduced, Mr. Currie, secretary, and Mr. De Harte, superintendent, responding to the toast of the "London Street Railway Company," and Mr. Carr to that of the "Manager of the Company." The toasts of the various departments were heartily received, and the pleasure of the occasion was greatly added to by songs by Mrs. Carr, Mr. Currie and Mr. Birmingham.

Mr. C. A. C. Pew, of St. Catharines, is promoting an extensive electric railway enterprise across the north-western portion of Ontario, from Port Perry to Lake Huron. It passes through the counties of Ontario, York, Simcoe, Cardwell, Grey and Bruce, and will touch at the towns of Newmarket, Bradford, Beeton, Shelburne, Priceville, Durham, Hanover, Walkerton, Meaford, Owen Sound, Southampton, Kincardine, Teesswater, Wingham and Goderich. All these places are now served by parallel lines of steam railways, radiating mostly from Toronto, and which necessitates, on the part of travellers, the making of long round-about journeys to go from any of the points named to another. The proposed electric road is therefore intended to promote a great public convenience, and is in consequence meeting with a very enthusiastic support all along its route. It crosses the G.T.R. and C.P.R. at several points, and will in a measure serve as a feeder for both roads. The part of the country it passes through is fertile and prosperous, and much in need of railway accommodation in the direction proposed. Large meetings in favor of the project have been held at all the towns named, at which money for preliminary expenses was freely subscribed. Parliament will be asked at its present session for a charter, which, when obtained, will be passed over to a New York company, which proposes to build and equip the road without asking either the government or municipalities for a bonus. The road is sure of an extensive traffic, and can scarcely fail to return large earnings to its owners. An abundance of water power exists along the route.

RECENT CANADIAN PATENTS.

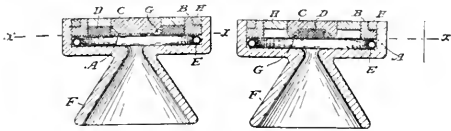
Patents have recently been granted in Canada for the following electrical and steam engineering devices:



APPARATUS FOR GENERATING ACETYLENE GAS.

Patentee: T. L. Willson, New York, N. Y., patented 5th November, 1895; 6 years.

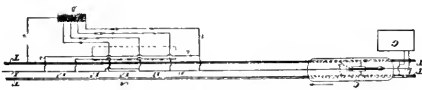
Claim.—The combination to form a gas-generating apparatus of a gas generator consisting of a chamber having a receptacle for carbide, a gas outlet from the upper part of the generator, a water inlet to the lower part thereof, and a source of water connected with said inlet under pressure sufficient to raise it above the level of the carbide, the whole adapted for automatic operation controlled by the relative pressures of the water and the generated gas, so that the water, after reaching the carbide is forced out of contact therewith whenever the gas is generated enough faster than it is consumed to raise its pressure above that of the water.



TELEPHONE SYSTEM.

Patentee: A. C. Brown, Lewisham, Eng., patented 2nd November, 1895; 6 years.

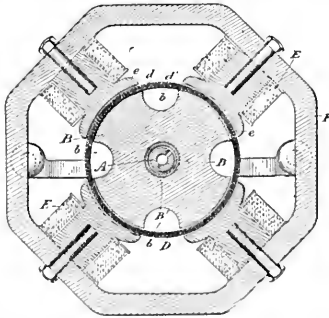
Claim.—In a telephone receiver the arrangement and combination of a central or cylindrical casing or ring seating with ear piece and with two diaphragms both adapted to be simultaneously vibrated in opposite directions to or from each other, and polarized by magnets. In a telephone receiver having two diaphragms clamped onto a cylindrical seating, the use for polarizing such diaphragms or cores of a split steel tube such as S, encircling the coils as above described, or for the same purpose of magnets arranged or adapted to operate substantially as above described and illustrated.



ELECTRIC RAILWAY SYSTEM.

Patentee: Canadian General Electric Co., Toronto, Ont., patented 18th November, 1895; 6 years.

Claim.—In an electric railway system, the combination with a vehicle electrically propelled, of means for stopping and starting said vehicle at definite points, consisting of a series of conductor sections located near such points and making connection with the vehicle, and a storage battery, having connections from points of different effective potential to the various sections, the potential decreasing from each end section toward the middle. In an electric railway system, the line or supply motor, a series of section conductors connected to said line through resistant or equivalent devices for lowering the effective electro-motive force of said sections from that of the line in a successive and graduated manner.

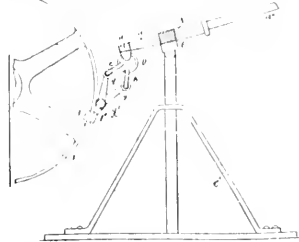


ELECTRIC MOTOR.

Patentee: Charles Riordan, of Toronto, Ont., patented 18th November, 1895; 6 years.

Claim.—In an electric motor the combination with the exterior

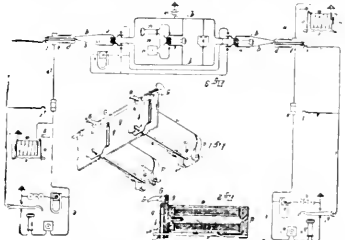
field magnets, of a hollow cylindrical armature comprised of wire loops suitably supported and secured to the main shaft of the motor and a solid core located within the armature magnetically insulated from and loose on the shaft and provided with recesses in its periphery between the ends of the cores of the field magnets whereby the lines of force maintain such core from rotating on the shaft, the armature supported on discs and comprised of a series of loops substantially rectangular, arranged in sets abutting each other, the sides of the loops of each set being arc-shaped, and each side being arranged to fit beneath the side of the adjacent loop of the set, so as to form a complete cylinder of double layer arc-shaped wire sides, the ends of the wire of each loop being connected to corresponding sections in the commutator.



LEVER FOR TURNING STEAM ENGINES OFF THEIR DEAD CENTRES.

Patentee: John Donnelly, St. Henri, Que; patented 2nd December, 1895; 6 years.

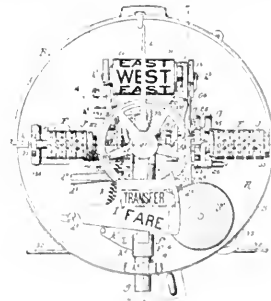
Claim.—On a lever for turning steam engines off their dead centres the combination of a lever A, having cross pieces b and a', two pieces a' and a', provided with the rings D and D', holding the ones E, to which is secured the levers g and g', of the grapples G, with a suitable stand C, and socket bar a'.



MULTIPLE SWITCH BOARD FOR TELEPHONE EXCHANGES.

Patentee: The Bell Telephone Company of Canada, Montreal, assignee of C. E. Scribner; patented 5th December, 1895; 6 years.

Claim.—The combination with an annunciator having an electro-magnet, a pivoted armature therefor, an indicator and mechanism is connected with said armature, and indicator adapted to actuate the indicator when the armature is vibrated between its extreme positions, of a circuit containing a source of pulsating currents, a source of continuous current and means for connecting said source of continuous current with the circuit, whereby the actuation of the indicator by pulsating currents may be prevented by connecting the source of continuous current with the said circuit. In an annunciator in a ground branch having an electro-magnet, a pivoted armature therefor, an indicator and a catch-arm carried by said armature having alternate teeth adapted to engage with and retain said indicator when the armature is in either of its extreme positions, but to release the same when the armature is vibrated, a connecting plug for insertion into any spring jack, having contact-pieces arranged to register with the corresponding contact-pieces of a spring jack, a conducting circuit joining the different contact-pieces of a plug, including a clearing-out annunciator, a source of current adapted to actuate said clearing-out annunciator.

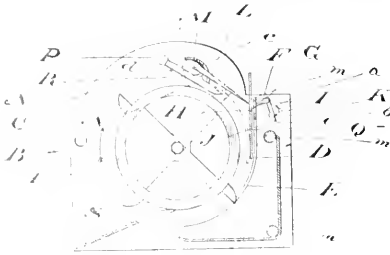


FARE REGISTER.

Patentee: The St. Louis Register Co., St. Louis, U. S. A.; patented 9th December, 1895; 6 years.

Claim.—The combination with the trip register, the permanent

register and means for releasing the trip-register, and for locking the permanent register against movement while the trip-register is released, of a motor for returning the trip-register to zero and means for actuating registers step by step and for unlocking the permanent register against movement while the trip-register is released. The combination with the registers and the fare indicating signal I of an arm for moving it in one direction, a longitudinally yielding pin for holding it in such position, and an oscillating pawl for depressing the pin to release the signal.



FARE BOX.

Patentee: J. H. Coleman, Tottenham, Ont.; patented 10th December, 1895; 6 years.

Claim. In a fare box, one or more needles arranged to permit of the insertion of fares into the box and automatically arranged to resist their withdrawal when the box is in a normal position. In a fare box, a concave and a rotatable toothed drum between which the fares pass, with needles having weighted tails to retain the points of the needles in the path of fares passing between the concave and the drum.

SPARKS.

The Bear River, N. S., Electric Co. have decided to extend their lighting system to Digby.

A franchise has been given to the Belleville Electric Company to construct an electric railway between Belleville and outlying villages.

D. Knechtel, of Hanover, has started up his first 10 h. p. induction motor operating from the monocyclic circuit. The operation of the motor is so satisfactory that Mr. Knechtel looks for a considerable power business in Hanover.

Mr. James Milne, lecturer in Electricity at the Toronto Technical School, held a preliminary examination for the class on the 27th of February. Although only a small number of students were present, the results were very satisfactory.

In the city of Montreal many ex-telegraph operators hold positions of trust and responsibility. Among those may be mentioned: Sir William Van Horne, president Canadian Pacific Railway; Mr. Charles W. Hays, general manager, and Mr. Geo. B. Reeves, general traffic manager Grand Trunk Railway; Mr. J. Stephenson, general superintendent Grand Trunk Railway; Mr. J. Bryce, superintendent Canadian Express Co., and Mr. Wm. MacKenzie, stock broker.

Mr. W. L. Gilchrist recently delivered a lecture at Victoria, B.C., on "Magnetism and Electricity."

The capital stock of the Toronto Electric Light Company, Limited, has been increased from \$700,000 to \$2,000,000.

The offices of the Kingston Light, Heat and Power Co. have been enlarged and equipped with modern appliances.

The Montgomery Electric Power Company, Quebec, are negotiating with the town of Levis to furnish 50 horse power for pumping apparatus and electricity sufficient for 80 arc and 2,000 incandescent lamps.

At the annual meeting of the Portage la Prairie Electric Light Company, Messrs. T. B. Millar, Judge Ryan, Hon. R. Watson, Smith Curtis and Mr. Blake were elected directors. The report presented showed a satisfactory year's business.

The Citizens' Light & Power Company, of Montreal, held its annual meeting early in February. Mayor Wilson-Smith was elected president, Mr. W. McLea Walbank, vice-president and managing director, and Mr. R. B. Hutcheson, secretary. The report showed that in the last month the company had obtained 25 new customers at meter rate, and 15 customers at flat rate. The directors elected for the ensuing year were: Major G. H. Burland, W. McLea Walbank, P. Lyall, M. P. Davis, L. H. Heneault, Mayor of Ste. Cenevide, and ex-Mayor Dagenais, of St. Henri.

A bonus of \$10,000 for an electric railway between Perth and Lanark has been granted by the last named town.

Joseph Barrett desires to secure a franchise from the city of Toronto to distribute light, heat and power.

Messrs. James Ogilvy & Sons, Montreal, are installing a 55 kilowatt and a 12 kilowatt C. G. E. multipolar machine for isolated lighting.

Mr. T. L. Wilson, of Calcium Carbide fame, is reported to have purchased power sites at St. Catherine's, Ont., with the intention of locating his Canadian works there.

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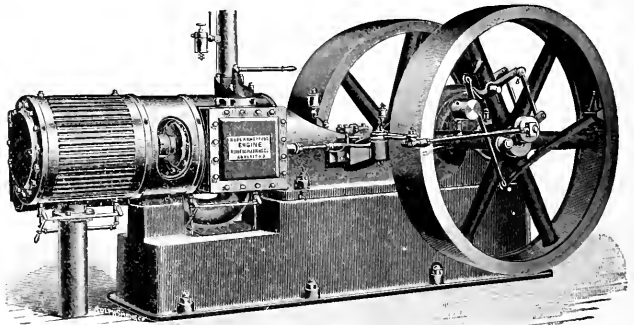
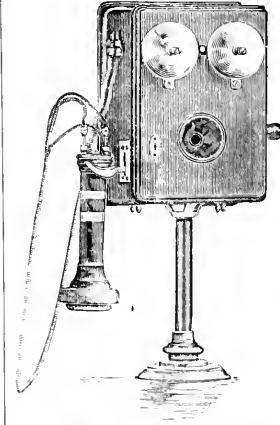
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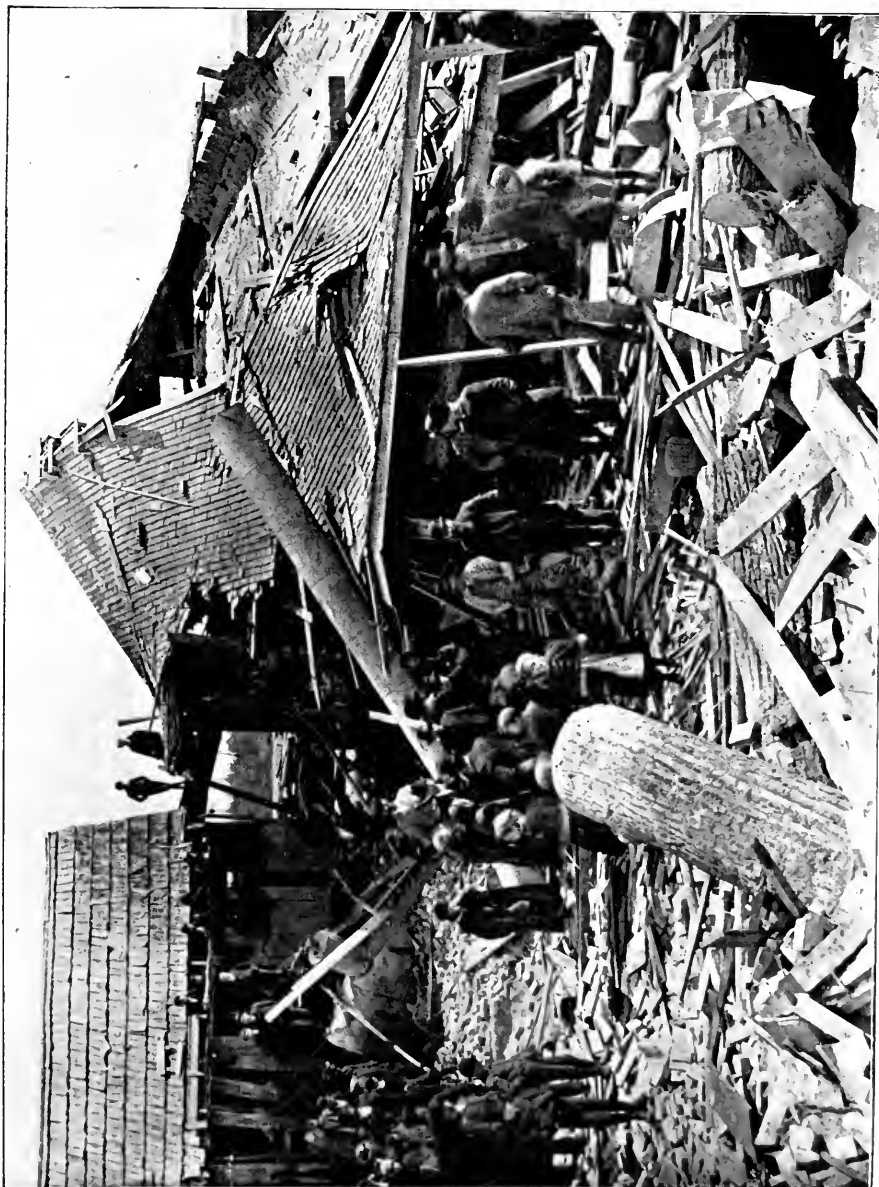
WM. McKAY, Seaforth, Ont., Travelling Agent.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VI.

MAY, 1896

No. 5.



BOILER EXPLOSION AT RIDGETOWN, ONT.

(For particulars see next page.)

BOILER EXPLOSION AT RIDGETOWN.

On the 6th of April a boiler exploded in the saw, stove and heading mill of Watson Bros., at Ridgetown, Ont., which completely wrecked the mill and has thus far resulted in the death of four persons. The accident occurred just as the employees were preparing to enter upon their day's work. The fire had been under the boiler for some time, but the machinery had only been in operation about a minute and a half.

The boiler was a horizontal tubular one, 54 inches diameter and 11 feet 6 inches long, with 58 tubes 3 in. in diameter, and a dome 20 in. diam. and 27 in. high. The plates were iron and were a little over one-quarter inch thick. The joints were all single riveted, the lap of plates being 2 in., and the rivets were 5/8 in. diam. and 2 in. pitch. Manhole was 15 in. by 11 1/2 in. and had a strengthening ring around it 1 1/2 in. by 3/8 in. The boiler was in general good order and fairly clean inside.

After explosion there was no evidence that the boiler had been neglected or had been carelessly used. The back head had been renewed at some time and was in very good condition, and evidently was stronger than the front head. The boiler had been used at a pressure of nearly 60 lbs. per sq. inch, and was supposed to be quite safe for a higher pressure. It apparently gave way first at the manhole, or near to it, and was split open from the top across the boiler. The manhole cover was picked up about 60 feet from the original position of the boiler, complete and uninjured, with bridge and bolt attached.

The dome was thrown about 600 feet, and the plate to which dome had been attached went about 700 feet in a different direction. The position of the front part of shell and of the back part confirm the theory that the boiler gave way first at the upper part, as these pieces were thrown in opposite directions and appear to have been turned end for end in their flight.

A second boiler which had no steam on at the time was thrown bodily over the engine and badly ruptured.

The violence of the explosion is clear proof that there was plenty of water in the boiler at the time, and the back head showed no sign of ever having been overheated. The quality of the plates seemed to be common boiler iron, and the most probable cause of the explosion was that the pressure carried was too high for the strength of the shell at the manhole and at base of dome. The severe strain put upon these parts had gradually weakened the boiler, so that it gave way at the ordinary working pressure.

How best to prevent similar accidents is a question well worth considering. In Great Britain, where so many boilers are in use, Government inspection has been carefully avoided, but the Boiler Explosions Act requires the user of a steam boiler to report to the Government every accident, no matter how trifling, and an investigation is held and the owner has to prove that he was using all proper precautions. Under this system the fault which led to the accident is traced out to the maker, or seller, or user of the boiler, and the blame fixed upon the right person.

The coroner's jury, in their verdict, stated that the cause of the explosion is unknown, but recommended that the government make it compulsory to users of steam boilers of all kinds to have them periodically inspected by competent boiler inspectors.

HAMILTON, ONT.

(Correspondence of the CANADIAN ELECTRICAL NEWS.)

THE dissensions which arose at the annual meeting of the Hamilton, Grimsby and Beamsville Railway, and which resulted in the election of Mr. T. W. Lester as president, have not yet subsided. The ex-president, Mr. C. J. Myles, has again secured a controlling interest, and has reinstated Mr. A. J. Nelles as superintendent. At the adjourned meeting of shareholders, held a fortnight ago, the Myles faction represented the majority of the stock. A special committee reported in favor of doubling the stock, as there was sufficient surplus to do so; the report was adopted. A motion by C. J. Myles, seconded by R. S. Martin, that Mr. A. J. Nelles be reinstated as manager and superintendent of the road, caused an animated discussion which lasted two hours. Mr. Myles alleged that since the deposition of Mr. Nelles as manager, there had been a decrease in the quantity of freight and number of passengers. The appointment was finally carried by a vote of the shareholders present. It is claimed by the supporters of the

Lester ticket, however, that the appointment rests entirely in the hands of the directors. It is said that an effort will also be made to compel the resignation of Mr. Adam Rutherford, secretary. The profits of the year amounted to \$11,143.53. Beyond the bonded and mortgaged debt, there is a floating debt of \$19,576.10. The directors decided not to urge the building of a line to Grimsby Park and Beamsville this year. It is to be hoped that an end will be put to dissensions within the company, which, if prolonged, must seriously affect its prosperity.

Mr. Powell, who was until recently engaged as engineer by the International Radial Railway Company, is maturing plans for the construction of an electric railway from Hamilton to Guelph, Berlin and Waterloo. Charters have already been granted for a road to connect these cities, and Mr. Powell will endeavor to secure one of these. If unsuccessful, a new charter will be applied for. The capital, it is said, will be furnished by capitalists of Toronto, Guelph and Cleveland. No bonuses will be asked from the municipalities.

If the various schemes projected by Mr. E. A. C. Pew were successfully carried into completion, his name would be handed down to posterity as one of the greatest promoters of electrical development of the nineteenth century. His latest project is to supply power to the city from the Welland river by overhead conduits, the plan being to tap the river about one and one-half miles from Wellandport and build a canal, six miles in length, to run the water at Jordan, where there is a fall of 32 feet.

The Hamilton Radial Railway Company, of which Mr. Pew is also the promoter, has been granted right of way by the City Council on a thirty-two year franchise, and have commenced the construction of the line between the city and Burlington Beach, which it is expected to have completed by Dominion Day. The power house will be located at Burlington, that village being almost midway between this city and Oakville. Tenders for engines and power machinery have been received, and the contract will be awarded at an early date.

The Simpson-Noble Electric Light & Power Company, the new concern organized to supply electric light in this city, turned on the current a fortnight ago. The poles are being erected on private property, as the company as yet have not permission to erect them on the streets. The offices are at 103 Macnab street.

The directors of the Hamilton and Dundas Railway have decided to convert the road from steam to a first-class electric line. The work will occupy about two months, and will probably be commenced by the first of July. A change will also be made in the equipment, the ties having already been contracted for. This step meets with the hearty approval of the citizens, who consider that the road in its present shape is not in keeping with modern developments in methods of railway construction and operation.

The Hamilton Street Railway Company have made application to the City Council for an amendment to the by-law whereby the company would not be required to pay the city such a large revenue. The matter has been left in abeyance until an audit is made by the city auditors of the company's books.

HAMILTON, April 30, 1896.

C. P. R. TELEGRAPH STORAGE BATTERY PLANT AT OTTAWA.

By W. J. CAMP.

THE Canadian Pacific Company's office at Ottawa, Ont., has been equipped with storage battery, and the old gravity entirely dispensed with. As there are some combinations different from those in use at other points, a description may prove of interest to your readers.

The cells used are those made by the Electric Accumulator Co., type E₉ being used for locals, and type C₃ for mains. The charging circuit varies from 230 to 250 volts. The locals are in 3 banks of 2 cells each; No. 3 and 4 being used for the local circuits in the main office, and No. 2 for supplying additional power on quad locals when extended to the Parliament buildings office (H. U.). These locals are charged through a small motor-generator, which gives a voltage of 6, with a capacity of 20 amperes on the generator side. The main batteries consist of 8 banks of 40 cells each, a total of 320. These are charged in groups of 80 cells each directly from the power circuit, a resistance being inserted to bring the current down to 1 1/4 amperes; or two banks can be charged simultaneously at the rate of 2 1/2 amperes. All single wires are worked from 40 cells positive or 40 cells negative. These cells also furnish the "short end" for quads. These two banks are arranged in duplicate, one lot being charged while the other is in use. As quad is not worked during the morning while parliament is in session, and only occasionally during the balance of the year, and it is found that sufficient current can be stored in the morning to last the quads for the rest of the day, the remaining 160 cells are not duplicated, and can only be charged while the quads are idle. The same applies to the cells for the quad legs battery. The total current for quads is obtained from 80 additional cells on each pole. This gives the "short end" about 88 volts and the total 264. As the longest quad from Ottawa is to Toronto (256 miles), this gives a good working margin.

Fig. 1 shows the arrangement of the charging and discharging switches for the mains. Those for the locals are the same. These switches are known as "double pole, double throw." The dotted lines show the charging current and the straight lines the discharging circuits. (Only one bank of 40 cells is shown in the diagram.) The charging is done, for instance, as follows: 9 and 11 are charged for one-third of the morning, 10 and 12 for one-third, and No. 2 local for the balance. During the afternoon and

evening one day, Nos. 5 and 7 and No. 3 local are charged, and the next day Nos. 6 and 8 and No. 4 local. As so much more work is performed by these cells, a much longer time than that required for the cells for quad working is needed to replace what has been taken out. All cells are kept fully charged, and should the power circuit give out, there is always sufficient current stored to work the office for a week or ten days. The automatic circuit opener opens the charging circuit should anything happen to the power wires, and prevents the batteries discharging back.

The transmitting circuits of the quads are a modification of the Jones system as used by the Postal Telegraph Co., a single pole-changer being placed on the polar side, and two of them on the neutral side, as shown in fig. 2. Opening PC throws line to P, and closing PC throws line to N. P gives positive currents only, and N gives negative. N and P are worked simultaneously, closing N and P gives the total current to the line, and opening them gives only the partial current of either polarity according to the position of PC. Each lead from the quads to batteries has a resistance of 700 ohms, made up by two 16 c.p. 110 volt incandescent lamps. The leads from the batteries to the single wires pass through one 16 c.p. 110 volt lamp for each wire.

It is intended to place storage for the locals in the H. U. office later, and the system for working locals in the main office has been designed with that end in view—the only change in the main office then being to move No. 2 local over to H. U. During

into quads, the same course is followed, except that switch S is not required on the repeater sets. To leg H. U. office on, the switch S remains on the left hand contact, the pegs for the sending and receiving sides are moved over to the two H. U. wires selected. The circuits now are as follows: For sending—Earth, batteries No. 2 and 3, switch S, key, transmitter, discs, strip B, H. U. sounder, key, earth; receiving—earth, batteries, relay, sounder, discs, strip C, H. U. sounder, earth. In each case the circuits have been increased to 40 ohms, plus the line resistance to H. U., but at the same time the battery power has been increased so that the current is about of the same strength as before. In practice we found that the line resistance was so small that it could be neglected, and that the two additional cells were quite sufficient.

The Milliken-Hicks repeaters are connected up in a different manner from that in use at any other place. The governor circuit is (when closed) in multiple with the coils of the transmitter. This appears to give much better results than when it is a distinct circuit. By connecting the jacks of two half sets together through a double-ended cord they can be used as ordinary single line repeaters.

At H. U. there are two complete sets of single line repeaters, a spring jack main line switch, and 12 single sets. Six of the spaces allotted to the single sets are arranged with three point switches and additional sounders so that they can be used as quad

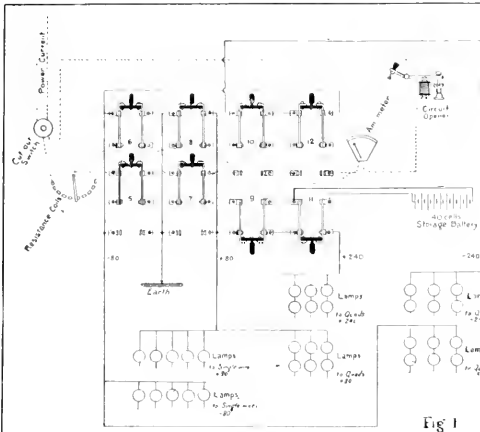


Fig 1

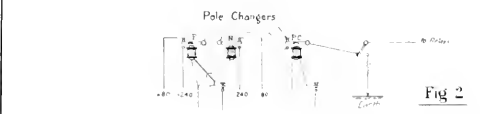


Fig 2



Fig 3

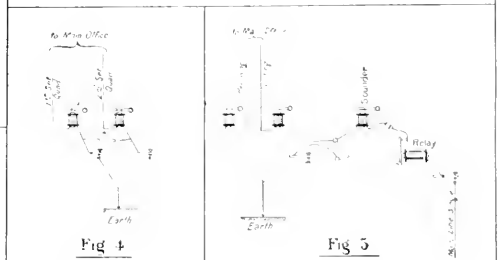


Fig 4

Fig 5

C. P. R. TELEGRAPH STORAGE BATTERY PLANT AT OTTAWA.

session of parliament it is preferable to have all wires end at H. U. Instead of connecting loops to wedges at the main office as is usual, all H. U. wires are connected with the upright bars in the main switch, and the single lines pegged through, making the main office a way one for the time being. Two wires are used for battery leads to H. U., one for each pole. Owing to limited space in H. U., all quads, etc., are placed in the main office and the locals extended to H. U. as required. In the main office there are three quads and six half Milliken repeaters, which are all connected to jacks as shown in fig. 3.

The arrangement of the locals is fully shown in fig. 3. All sounders, transmitters, etc., are wound to 20 ohms. Normally the small 3 point switch (which is placed on the operating tables) is turned to the left, and each sending and receiving circuit of three quads are pegged to the upright strip marked R in the main switch. The receiving circuit can be traced as follows: Battery No. 3 (positive), relay armature, sounder, disc, strip R, to negative pole of battery No. 3. The leg from sounder through jack, being open at switch S, remains "dead." The sending circuit is as follows: Positive of battery No. 3, switch S, key, transmitter, disc strip R, to negative pole of battery No. 3. There being no earth on either circuit except on the negative pole of battery No. 2, that battery is not drawn on for any current. To work as repeaters the switch S on each set is turned to the right, and a double-ended cord connects the top of one jack with the bottom of the other, and vice versa. Although only one-half quad is shown, the circuits can be readily followed. For instance, starting with No. 1 set, battery, relay armature, jack (top) cord and wedges, bottom of jack for second set, switch S on No. 2 set, key, transmitter, disc, strip R, to negative pole of battery. Starting from No. 2 set a similar course is followed. The leg through sounder is not disturbed, and that circuit is the same as for ordinary working. It may be noted that each circuit has only a resistance of 20 ohms. To work single lines

legs. There are also a couple of ingenious arrangements that are very convenient, and which I do not remember to have seen described before. They were put in by Mr. Bott, the Ottawa manager. One is to connect the legs of two half quads so that one operator is able to send simultaneously in both directions; this is shown in fig. 4; for the other ends of these circuits see fig. 3. The two point switch connects the two sets together, one key is left open, and the operator sends on the other. These sets are placed side by side, and the operator is able to hear the breaks on the receiving sounders. Of course the breaks do not carry through, but it is not necessary that they should do so. The other arrangement is to work a single line into a half quad, and is so clearly shown in fig. 5 that it is not necessary to describe it.

The shareholders of the London Street Railway Company will hold a special meeting on the 21st of May to authorize an increase of the capital stock of the Company to the amount of \$750,000 or less, and also to authorize the issue of debentures to the same amount.

The Victoria, B. C., Electric Railway and Lighting Co.'s property and franchise was offered for sale by auction, on the 10th inst., by order of the bondholders. The bidding was opened at \$200,000, and went up to \$340,000, when the property was disposed of to Mr. F. S. Barnard, M. P., of the Consolidated Electric Railway Company, who represents an English syndicate. The new owners will continue to operate the road, and will make a number of improvements. The property is a valuable one, the total mileage now in operation including about thirteen miles of track and switches, with seventeen cars and two trailers. The tramway company was first incorporated in 1880 under the name of the National Electric Tramway & Lighting Co., Limited, and in 1884 the name was changed to the Victoria Electric Railway & Lighting Co., Limited.

POWER STATION RECORDS.

THE advantages to be derived from keeping accurate records of the working of power plants are evidently thoroughly understood by the management of the Montreal Street Railway Company. An examination of the accompanying table, showing the results of the operation of the power station of that company for the year ending September 30, last, will, no doubt, prove interesting. Such records are very valuable for purposes of comparison, and should be kept by the managers of all electric light and railway power stations. We would be pleased to receive, at any time, similar tests for publication in this journal.

The routes of the Montreal street railway are laid out on a slope which rises gradually northward from the river to the base of Mount Royal. The north and south lines, therefore, are on a continuous grade, but the lines running east and west are comparatively level. About 140 cars are in operation in summer, and 100 in winter.

The six engines used in the power house are of the cross compound Corliss type, belted direct to the generators. Their cylinders are 24 in. and 48 in. x 48 in. stroke. They are rated at 600 h. p. each, and the statement shows that they have averaged as high as 643

pull per ton throughout the system, which was the most severe, as might be expected, throughout the winter months. The usual custom of starting with the draw bar pull as measured by a dynamometer and working up to the power station effort the average draw pull has been calculated.

THE N. E. L. A. CONVENTION.

THE National Electric Light Association of the United States will meet in convention in New York City, on the 5th, 6th and 7th inst. There will be held in connection with this convention an electrical exposition, illustrative of past and present developments in the applications of electricity. This exposition promises to be most complete, interesting and instructive, and will probably be the means of attracting an unusually large attendance.

Following is a partial list of the papers to be read and discussed at this meeting.

"Single-Phase Self-Starting Synchronous Motors," by F. H. Leonard; "Results Accomplished in Distribution of Light and power by Alternating Currents," by W. S. Emmet; "Acetylene Gas," by Mr. Ferguson, of the Chicago Edison Company; "Evolution of the Arc Lamp," by L. H. Rogers; "Steam

PERIOD—1895.	Coal Consumed Tons (2,240 lbs.)		Car Miles Run.		Coal Consumed per Mile		Engines carried		Ton Miles (2,240 lbs. per Ton)		Coal Consumed per Ton Mile		Coal Consumed per Horse Power Hour		Watt Hours and Electrical Horse Power Hours		MOTOR CARS.	
	Motor	Tramway	Total	Miles	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total
October	1,572.8	4,757.7	6,330.5	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
November	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
December	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
January	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
February	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
March	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
April (1st to 17th)	872.8	2,544.0	3,416.8	24,016	104.8	3,416.8	4.2	72,237	1,222,370	72,237	1,222,370	500	500	500	500	500	500	500
May (18th to 31st)	841.7	2,515.5	3,357.2	24,016	104.8	3,357.2	4.2	69,700	1,197,770	69,700	1,197,770	480	480	480	480	480	480	480
June	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
July	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
August	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
September	1,438.9	4,822.2	6,261.1	42,016	151.6	7,808.1	4.2	144,475	2,444,770	147,275	3,136,600	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Twelve Months	12,171.4	35,757.2	47,928.6	324,016	1,416.8	47,928.6	4.2	888,950	14,666,770	888,950	14,666,770	4,000	4,000	4,000	4,000	4,000	4,000	4,000

a Including sweeper and snow car mileage, 141.
b Including sweeper and snow car mileage, 2,240.
c Including sweeper and snow car mileage, 6,770.

d Including sweeper and snow car mileage, 11,000.
e Including sweeper and snow car mileage, 1,000.
f Engines running and consuming fuel from 18th to 31st.

g Coal, 1,000 tons screenings, 500 tons run of mine.
h Coal, 1,750 tons screenings, 1,250 tons run of mine.
i Coal, 1,750 tons screenings, 1,250 tons run of mine.

j Coal, 1,600 tons screenings, 100 tons run of mine.

GRANVILLE C. CROSBY, Manager and Chief Engineer

POWER STATION RECORD OF THE MONTREAL STREET RAILWAY COMPANY FOR THE YEAR ENDING SEPTEMBER 30, 1895.

e. h. p. for an entire month. The engines were built by the Laurie Engine Company, of Montreal, and are run condensing. The boilers, fifteen in number, are of the Lancashire type, made in England, and are rated at 300 h. p. each. Two Green economizers are used, and the temperature of the feedwater, when both economizers are on, is 245 to 250 degs. F. When one economizer is off for cleaning and repairs, the temperature of the feedwater drops to about 190 degs. Fah. The fluctuations in the amount of coal consumed per electrical horse power, shown in the table, are due largely to changes in the temperature of the feedwater when the economizer is on or off.

The table shows a great increase in coal consumption per horse power when the engines were run non-condensing as compared with condensing, and also that screenings were used for fuel with satisfactory results, the consumption per horse power being no greater and the cost much less. In the column entitled "Watts per Ton Mile," the amount of power used to move a ton one mile on the system is shown. The power used was the highest in November and gradually decreased until May. Most of this decrease may be attributed to better weather, but a portion of it is due to improved controllers being put on the cars, and also that less power was used for light in summer than in winter.

The figures in the last column show the average draw

Boilers, Their Equipment and Management," by Albert A. Cary; "Electrolysis," by William Brophy; "Evolution of Interior Conduits, From an Electrical Standpoint," by Luther Steiring; Lecture.—"The Light of the Future," by D. McFarlan Moore. Topic.—"The Desirability of a Standard Socket," discussion to be opened by Alfred Swan.

The sessions will be held in one of the large rooms in the Industrial Building, Lexington avenue and Forty-third street. The hotel headquarters will be the Murray Hill Hotel, Park avenue and Forty-first street, within two blocks of the convention hall. The hotel rates to delegates have been fixed at \$2.00 per day and upward on the European plan; \$4 and upward on the American plan.

Canadians will doubtless feel more than ordinary interest in this convention from the fact that in all probability Mr. Frederic Nicholls, manager of the Canadian General Electric Co., will be the next president of the National Electric Light Association.

A soft copper hammer makes an excellent tool with which to drive keys on an engine.

Eccentrics for steam engines that are made in halves may easily be procured, and where an old one has been split off from a crank shaft, one of them is much more easily applied than a whole one. If well made they should last as long as when made in one piece.

BY THE WAY.

As illustrating the many absurd arguments advanced by a certain class of electric railway "promoters," a gentleman named Beech has recently been endeavoring to get capital subscribed by the farmers in the neighborhood of Ridgeway for a single track elevated road to extend from Ridgeway to Crystal Beach on the shore of Lake Erie, a distance of 3 or 4 miles. Mr. Beech is an American and is gifted with a ready flow of language of the stump orator type. At a recent meeting of the residents of the locality, principally farmers, he occupied considerable time in expatiating upon the advantages of his particular system over the ordinary trolley system and stated among other things that the cost of operation of the overhead single track system would be but one-tenth of that of the ordinary trolley road. A gentleman in the audience acquainted with the subject, was asked to make an estimate of the cost per day of operating a trolley line, and he figured the amount at \$17.00 per day. This estimate included the salaries of three men. This gentleman inquired of the "promoter" of the single track scheme if he had correctly understood him to say that a road built on that system would cost to operate but one-tenth of that required for a trolley road. Mr. Beech promptly replied that that was his contention. "Then," said the gentleman, "will you kindly explain to the audience how you propose to operate the road and pay three men's salaries out of the sum of \$1.75 per day?" This problem proved to be a trifle beyond the mathematical ability of the "promoter," and remained unanswered. Strangely enough there were persons present at this meeting who would not have subscribed towards the construction of an ordinary trolley road, but were willing to pay out their good dollars for the overhead single track scheme. The absurdity of going to the expense of erecting an overhead system for a line designed to run along a country roadside does not seem to have occurred to the minds of the people who have been solicited to put up money for the enterprise. I understand that some \$3,000 has been subscribed for the purpose of enabling the "promoter" to construct a piece of track with which to illustrate the advantages of his system. Speaking of the peculiarities of "promoters," I am informed that one of the most active individuals in this line in Canada is making a handsome income out of the business. His method is to project an electric railway and induce municipalities along the route to subscribe say \$500 apiece for what he is pleased to term "preliminary expenses." He frankly tells them that in the event of the scheme proving unsuccessful they need not expect to get their money back, and it is hinted that the money thus obtained never goes any farther than his own pocket.

x x x x

THE Toronto Electric Light Co. had in their employ at one time a tall French lineman whose agility was such that he was accustomed to use only one hand when climbing a pole. At the corner of King and Yonge streets stood a pole requiring an additional cross-arm which this dexterous lineman undertook to carry up in his disengaged hand. When part way up the pole, the cross-arm slipped from his grasp and descended perpendicularly upon the crown of the silk hat of a gentleman on the street, driving the hat down upon his shoulders and entirely obscuring his face. He struggled unsuccessfully to get out of the hat until the

Frenchman came down the pole and assisted in removing it. The victim had no sooner got his breath than he turned his attention to the unfortunate lineman, and bestowed on him all the anathemas which his recollection could muster. The victim took his punishment patiently, and at its conclusion invited the gentleman into a hat store near by and bought him a shining tile of the newest pattern, thereby metaphorically heaping coals of fire upon his head while at the same time getting rid of the possibility of a claim for damages against his company.

x x x x

I HAPPENED to witness an amusing incident in the office of the G. N. W. Telegraph Co. at Toronto, not long ago. A well-known business man came in and asked the price of a cable message. Having been given the rate, he began trying to get a reduction, advancing as a reason for his unusual request that he had been a good customer of the Company, and like all good customers was entitled to some extra consideration. An amused expression came into the face of the young man behind the counter as he remarked, "Let us see! you have paid us for cable messages altogether about twenty dollars." "Yes," said the customer, and the tone of his voice implied that he considered that a pretty large sum and quite sufficient to justify his claim. "You may be surprised to learn," said the polite young man behind the counter, "that out of this twenty dollars, the percentage to which this Company is entitled amounts to the magnificent sum of one dollar." After this explanation the customer did not see fit to press his claim further. The fact may not be widely known that the cable companies get the lion's share of the money paid for cable messages, and that the telegraph companies who despatch the messages overland across half a continent, receive but a fraction of the price.

PERSONAL.

Mr. T. Ahearn, of the Ottawa Electric Co., is expected to return this week from his trip round the world.

Mr. James Ross, vice-president of the Montreal Street Railway Co., sailed for England on the 6th of April on a pleasure trip.

Mr. S. J. Stratton, of the Bell Telephone Company, Hamilton, accompanied by Mrs. Stratton, is at present in England, for the benefit of Mrs. Stratton's health.

Mr. E. B. Merrill, formerly lecturer in electricity at the Toronto Technical School has recently accepted a position with the J. H. McEwen Manufacturing Co., of Ridgway, Pa.

Upon severing his connection with the Kingston Light, Heat and Power Company, Mr. John Oldfin was presented by the employees with a beautiful oak secretary. Mr. Oldfin had been in the employ of the company for twenty-nine years.

Mr. O. Higman, chief electrician of the Inland Revenue Department, Ottawa, was recently offered the position of electrical engineer for the colony of Queensland, Australia, at a salary of \$3,000. The Dominion government offered to Mr. Higman such inducements to remain in his present position, that he declined the foreign offer.

TRADE NOTES.

Messrs. Patterson & Corbin, of St. Catharines, Ont., have received an order for four cars for the Hamilton Radial Railway Company.

The attention of persons on the lookout for a bargain in second-hand alternating machinery is directed to the advertisement of Messrs. Ahearn & Soper in this issue.

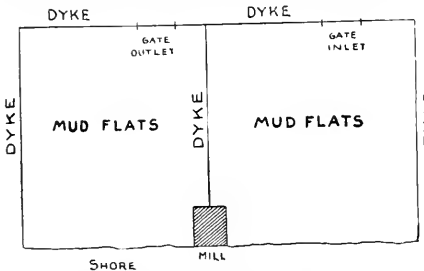
In the article in our April issue referring to the equipment of the Hull and Aylmer Electric Railway, mention was omitted of the fact that the contract for trolley, feed and bond wire, amounting to some 150,000 lbs., had been awarded to the Eugene F. Phillips Electrical Works, Montreal.

QUESTIONS AND ANSWERS.

H. S. P., Toronto, writes: "How many pounds pressure of air will be required to the sq. inch, taking the full piston plate surface, to force the rod (1 inch diameter) into dead cylinder against an air pressure of 50 lbs. to the sq. inch, speed say 1 ft. in 1 minute. Would it be a pressure a little over the difference in the dead cylinder pressure and the pressure raised by the rod displacing that amount of air?"

ANSWER.—A pressure of 14 to 15 lbs. per sq. inch on the piston 6 in. diam. would just balance the resistance of 50 lbs. per sq. inch on end of rod. A pressure of 2 lbs. per sq. inch would probably start it in motion, and if pressure remains constant in the dead cylinder, that pressure would be sufficient to do what you require.

E. L. NASH, Lunenburg, Nova Scotia, writes: "Do you know of any place where the new style of tide mill is in successful use. I mean one working on the accompanying plan. We have a back harbor here



where the tide rises and falls about six feet, and want to know if it is feasible to build dykes and run our electric machinery by a tide mill. Where could I get hold of calculations that would enable me to tell how much would have to be dyked in to develop 500 horse power continuously?"

ANSWER.—It is difficult to give a definite answer to your question without considerable more data than you give. On general principles, however, it is doubtful if a tide of only six feet could be made available within the limits of commercial practicability. In the first place it would be impossible for the power to be developed continuously under ordinary circumstances, as at high tide, which occurs twice in twenty-four hours or thereabouts, there would be no fall whatever available, and consequently no power. On the contrary, at those times the reservoirs would be filling up. From the sketch you send, however, we suppose your idea would be to have several reservoirs and during high tide to empty from one into another and then from that out. If that plan were adopted you could only figure on an average head of about three feet. To produce 500 horse power at this head would require two reservoirs, probably about 3500 feet square and 6 feet deep, or nearly five miles of dyking, to say nothing of the heavy cost of machinery to produce power with such a small average head. There are no doubt a few tidal mills on a small scale in operation, where the power is not required continuously, but we do not know of any of the importance or capacity of the size you speak of. In fact in considering the matter of continuous power, and considering the fluctuation in level which would have to be taken into account, it is altogether probable that the reservoirs would have to be considerably larger than the size given above to obtain satisfactory operation. It would appear that the interest on the first cost and the amount required for repair and maintenance, would be infinitely greater than the cost of coal to produce an equal power, especially in the neighborhood you speak of.

"Novice" writes, in reply to "Induction's" enquiry in a previous issue:—This open circuit business is the terror of arc light men as a rule. I would like to see the matter discussed through the ELECTRICAL NEWS and am sure some good would result from such discussion.

The writer has had a little experience in finding breaks that could not be located by climbing every pole on the circuit, and pulling the wires, and if your space will permit, will be pleased to explain his method. I first divided the circuit into sections with small magnet wire, sometimes running it two blocks at a stretch, and found that the break was nearer the negative end of dynamo than the positive. Then I grounded that end of line at the dynamo, being careful to disconnect the positive wire. With the magneto bell I started out and every arc lamp I came to on the street I let down and fastened one wire of bell to binding post of lamp, and the other to the ground. As long as the bell would ring I knew I had farther to go. As soon as the bell would not ring I knew I had my break down to close quarters, and started back towards the last place where the bell would ring, testing from the line as we went, and very soon had only about 100 feet of line untested. The rest was easy. It may seem to some that this would be a tedious way of finding a break, but we were only about an hour at it. I would like to hear from some one else who has a scheme.

CANADIAN ELECTRICAL ASSOCIATION.



WEDNESDAY, Thursday and Friday, June 17th, 18th and 19th, have been selected as the dates of the annual convention of the above Association. It is somewhat unfortunate that the Dominion elections have been fixed for June, but it was not deemed advisable to postpone the convention on this account. So far as the election canvass is concerned, it will be practically concluded, and the nominations over by the 17th of June, while voting will not take place until the 23rd.

Those members of the Association who take an active interest in politics, should get their work done before the 17th, and spend two or three pleasant and profitable days at the Toronto convention before depositing their ballots. Then if the party of their choice should happen to be defeated, they will find themselves in good condition to put up with the disappointment, while if the vote goes to their liking, they will be in equally good trim to join in the enthusiasm of the occasion.

The program for the convention is an attractive one. Papers will be presented as follows: "Economics of Central Station Management," by P. G. Gosselin, Montreal; "Acetylene Gas," by Geo. Black, Hamilton, Ont.; "Meters," by James Milne, Toronto; "Electric Railway Construction," by F. C. Armstrong, Toronto; "Power Transmission by Polyphasic E. M. F.'s," by Geo. White-Fraser, E. E., Toronto; "Continued Use of Water of Condensation," by Wilson Philips, Toronto.

Several of these papers will be illustrated by means of a stereopticon, a new feature which will add greatly to the interest of the proceedings. Opportunity will be afforded for the consideration and discussion of the Government Electric Light Inspection Act.

It is in contemplation to hold the annual banquet of the Association at Lorne Park, Niagara-on-the-Lake, or some other popular summer resort in the vicinity of Toronto. The banquet will be followed by a moonlight sail on Lake Ontario, the steamer being attractively decorated and provided with music for the occasion.

There will likewise be visits of inspection to the power stations of the Toronto Electric Light Co. and Toronto Railway Co., an exhibition of Roentgen rays, excursions by street car, etc. Altogether, visitors are assured of an interesting and profitable time, and seeing that a large proportion of the members of the Association reside within a hundred miles of Toronto, there should be a bumper attendance.

The Hamilton Radial Electric Railway Co. have awarded the contract for the electrical generating apparatus required for the operation of their road to the Canadian General Electric Co., Ltd.

THE INCANDESCENT LAMP.

By GEORGE WHITE-FRANER, E. E.
(Concluded.)

Diagram 4 also serves to illustrate the various wattages at which lamps can be run, and their effect on life and candle power. Running the lamps at 108 volts is equal to a wattage of 3.5 per c. p. Running them at 110 v. equals 3.3 watts per c. p.; at 112 equals 3.1 watts; at 114 equals 2.9 watts; at 116 equals 2.7 watts per c. p. The higher therefore the economy at which this lamp

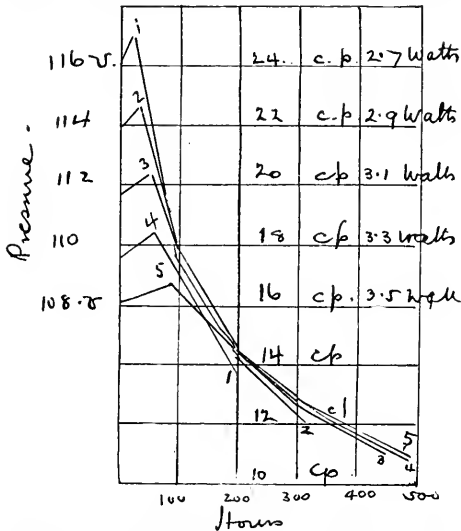


FIG. 4.—CURVE SHOWING DEPRECIATION OF CANDLE POWER CONSEQUENT ON USING TOO HIGH VOLTAGE.

was run, the sooner did it come down to a low candle power, and the sooner did it burn out, so that the lower efficiency was in this case the higher economy. This point is well illustrated by the curves in diagram 5 which shows the results of burning a lamp of the same make at different efficiencies. At the highest efficiency—2½ watts per c. p.—the lamp drops to 8 c. p. at 600 hours, and as the efficiency becomes less, that is as the wattage grows more per c. p.; the reduction in c. p. becomes less and less, the life longer and longer.

These curves are very suggestive to the observant central station man, as indicating the policy which should govern him in the supply of lamps, and in the system of wiring. It is evident from a careful study, that if his distribution system is so laid out that the variation in pressure between heavy and light load is relatively great, then he had better use his low efficiency lamps, for such variation will cause the lamps to drop in candle power and burn out soon, and cause dissatisfaction among his customers.

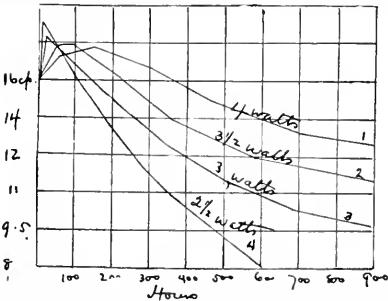


FIG. 5.—CURVE SHOWING EFFECT ON CANDLE POWER AND LIFE OF RUNNING AT DIFFERENT EFFICIENCIES.

If, however he has used plenty of wire, so that the variation is small, then he can use high efficiency lamps. By this means he can put a good many more lamps on his dynamo, which means increased profits. The matter, however, is much more complicated when he furnishes light to meter customers. In this case he does not sell light merely trusting to the inexperience of his customers not to detect the difference between the 16 c. p. they contract for, and the 12 or 10 c. p. that they actually get. He sells current, and it is plain that the more current he sells, the better for himself, so that he should study how to increase the amount of

current that the consumer takes. He cannot, of course, make that consumer keep his lamps burning, but a study of lamp curves will point out a way. Diagrams 1 and 2 show the decrease of candle power as a lamp grows older, No. 3 shows the increase of wattage per candle power during the same period; although the lamp takes a higher wattage per candle power as it ages, its candle power decreases more rapidly than the wattage increases, so that the absolute wattage slowly all the time. Profit therefore also keeps on diminishing in the same ratio.

Diagram No. 6 shows these changes in three curves. A, B, C, taken from a 3½ watt lamp. Curve A shows its decrease in absolute candle power, giving actual candle power observed at 100 hour periods during its life; curve B shows the increase in wattage per candle power at the same periods, and curve C shows the resultant of the two at same periods, that is at 700 hours the actual candle power given is 12.25; the wattage per c. p. is 3.79; and the actual watts absorbed by the lamp are (curve C) 45.5. Now the lamp at the first 100 hours absorbed 57.2 watts, so at 700 hours it is absorbing 11.7 watts less, and what is interesting to the station man—is paying less in proportion—less by

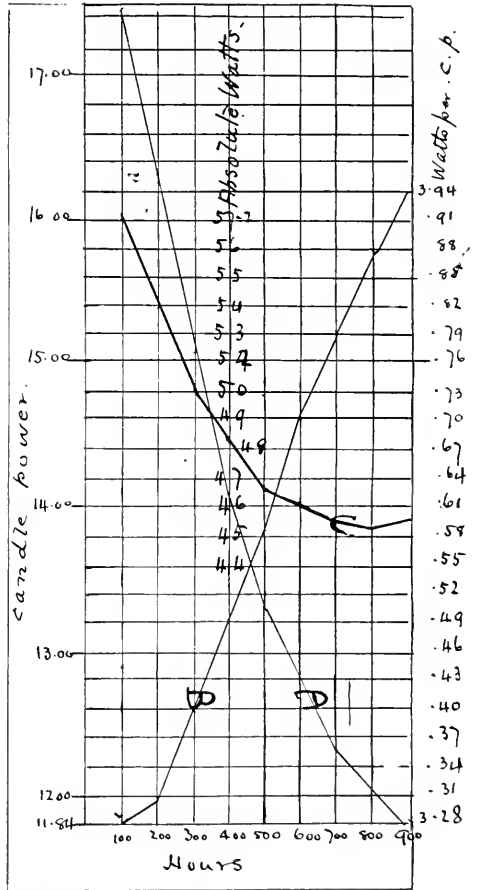
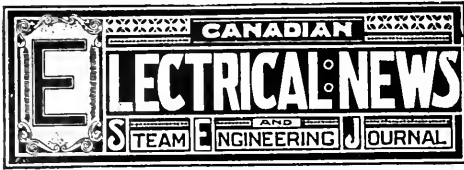


FIG. 6. CURVES SHOWING DECREASE IN C.P.; INCREASE OF RELATIVE WATTS, AND DECREASE OF ABSOLUTE WATTS, AS LAMP AGES.

21 per cent. Dividends can never be paid at this rate, for it simply amounts to a 1000 light plant installed at a 1000 light price, earning only 700 lamps' worth of rent. So we must keep up the supply of current, and this can only be done by putting old lamps out of service, when they begin to take so little current, and putting in new ones that will take more. It seems extraordinary, but it would actually pay to break this lamp rather than run it 700 hours.

A study of lamps will reveal other apparently paradoxical results, and the conclusion of the whole matter is (1st) Study your distribution system, and keep your pressure as constant as possible, even if it costs a little more money to reduce the drops on lines, (2nd) Don't assume that the cheapest lamp is the best, nor even that the one with the longest guaranteed life is the one you want, (3rd) Buy lamps to suit your work, for all lamps are by no means alike, and study what your work will be, (4th) Don't imagine that once you have put a lamp in its socket, the matter is disposed of, and you need pay no more attention to it—lamps may be actually losing money to you. Above all remember that your entire lighting business is worth careful study.



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; F. Merrill, Secretary, 352 Wellington street.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeger, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. J. R. Utley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King street, at 8 p.m. President, S. Donnelly; Vice-President, Henry Hopkins; Secretary, J. W. Lindvin.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

WIARTON BRANCH NO. 13.—President, Wm. Craddock; Rec.-Secretary, Ed. Dunham.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. S. Potter, President; C. Robison, Vice-President; W. Sharp, engineer steam laundry, Charlotte street, Secretary.

BROCKVILLE BRANCH NO. 15.—President, W. F. Chapman; Vice-President, A. Franklin; Recording Secretary, Wm. Robinson.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

Electric Railway Legislation.

The Hon. John Haggart, Minister of Railways, recently made the announcement that the Dominion government is of opinion that all electric railway charters of a purely local character should be left to the jurisdiction of the provincial authorities. The Railway Committee of the Dominion Parliament is not in accord with this view, and has reported to the House several bills of the character mentioned contrary to the wishes of the government.

Electric Light Inspection.

COMPLAINTS have reached us lately concerning the system of electric light inspection inaugurated by the Dominion Government a year ago. There seem to exist doubts in the minds of some, first, regarding the necessity for such a system, and secondly, concerning the fairness of the charges imposed and the efficiency with which the Act is administered. Our attention has been called to instances in which meters, after having been tested and sealed up by the government inspectors, shortly afterwards ceased to operate owing to the formation of a substance upon the brushes which retarded and eventually stopped entirely the action of the commutator. We have likewise heard complaints of the action of some of the government inspectors in posing as electrical engineers, and advising central station owners as to the means they should adopt to overcome difficulties experienced in the operation of their plant. It is affirmed that the inspectors are without the training necessary to qualify them to act in this capacity, and that in some instances their advice has caused unnecessary friction between central station owners and the manufacturing companies. We propose to investigate this subject and if possible learn to what extent these complaints are well-founded.

**Effect of Electric
Railways on the
Labor Problem.**

Mr. Bronson, in moving a resolution in the Ontario legislature setting forth the desirability of forming societies in cities to assist in placing unemployed persons on the unoccupied lands of the province where they might become self-supporting and even contributors to the development and wealth of the country, expressed the opinion that electric railways would prove important factors to this end. While it is undoubtedly true that the means of intercommunication afforded by electric railways will do away with the isolation, which is one of the greatest objections to country life, the lands upon which the class in question could be settled are likely to be situated in localities where electric railways will not be built for many years to come. Therefore the electric railway is not likely to prove a factor in their welfare.

Anchor Ice.

THE difficulties encountered by electric stations operated by water power, in consequence of the formation of anchor ice, was the subject of some discussion at the convention of the Canadian Electrical Association at Ottawa last September. The consensus of opinion seemed to be that there was no method by which the difficulty could be avoided. In the Scientific Machinist of Cleveland, this method is given of keeping the turbines free of ice, "bore a hole in the top of the wheel case, or drill a hole if the case be an iron one, and connect on a steam pipe. When a wheel freezes up, or shows signs of freezing, just turn on steam for a few minutes, and away goes the ice, slick and clean. The wheel, of course, must be shut down before the steam is turned on, or all the heat will be carried off with the water, leaving the ice as good as before steam was turned on." Mr. James F. Ward, in a letter to the Engineering Record, states that while chief engineer and superintendent of the Jersey City water-works he remedied trouble from this cause, by moving across the screen of the intake chamber a raft made out of some 12 inch square logs. His explanation of the success of the remedy is that in consequence of the length of the line around the edge of the raft being, say four times greater than the width of the screen, the force available to draw in the anchor ice is reduced in the same proportion. This very simple and apparently effectual remedy is within the reach of all who annually experience difficulty from the action of anchor ice.

**The Adaptability of
Machines to Require-
ments.**

THE popularity of electricity as a means for the transmission and utilization of power, and the recognition of its thoroughly satisfactory results, are in no way more evident than in the rapidity with which it is being applied to every conceivable purpose; and in the number of electrical manufacturing establishments that are going into the business. A perusal of the Patent Office Records shows how immense is the activity in the field of inventing new, and improving old types; and the establishment of electrical engineering courses in all large colleges, and the equipment of laboratories with the most expensive instruments, shows that practical electricity is now well out of the "rule of thumb" stage, and is recognized as being based on scientific principles. Electrical knowledge being so widely disseminated, the improvement in the designing, constructing, and operating of electrical machinery and apparatus

has taken place all along the line simultaneously, and electrical investors now have the assurance, not only that what they buy represents the results of scientific investigation, but that the market is full of excellent machinery, with something to suit every purchaser, and meet every want. Not so long ago, when electrical machinery was built by experiment rather than by calculation, it was only reasonable to believe that the inventor with the longest purse would produce the best apparatus, because he was better able to experiment until he overcame his difficulties, than another person without those financial advantages. But now that the design and construction of the highest class electrical machinery is a matter of certain knowledge; and is no more a matter of doubt than is the design of a steam engine or any other perfectly understood apparatus, it must be evident that any properly trained engineer will be able to produce good machinery; and not only this, but that suitable machinery can easily be built to meet the conditions of any particular case. The immediate result of the establishing of the principles governing electrical design and construction on a thoroughly satisfactory rational basis, instead of heretofore on a constantly changing empirical one, has been that nearly all large engine or machine manufacturing companies have added to their former business an electrical manufacturing department; and the result is that, whereas even five years ago the different makes of electrical machinery might be almost counted on two hands, to-day they are well up among the scores, and every one of them good. Another very important result is the splitting up of electrical manufacturing business into specialties, whereby the very highest perfection is attained along the several lines followed. Five years ago the few manufacturing companies there were, manufactured complete "systems," covering generators, motors, lamps, instruments, etc., etc., and to do business with them meant committing oneself exclusively to the particular company at first chosen, because one generally found that the use of a particular generator necessitated the use of a particular motor, and so on. Now, however, there are highly trained electricians who devote themselves exclusively to the perfection of one particular line of apparatus—be it motors, or arc lamps, or electric fans; and hence it is that the market presents a whole host of first-class machinery and apparatus from which the purchaser can choose.

Of course it is true, however, that while there are very many good makes, there are also a great number of types which have been long left behind in the race of improvement and which represent the earlier stages of design when scientific investigation had not clearly lighted up the subject. There, naturally, will also be found manufacturers, who, to meet competition, will purposely lower the quality of their goods, trusting to favorable circumstances not to be found out. Against these the purchaser will have to adopt such precautions as commend themselves to him, remembering that cheapness is *prima facie* evidence of relative inferiority. A really good machine costs money to build; both because high class material is expensive, and because skilled workmanship cannot be obtained for the price of day labor. But, the difference between good and inferior machinery is not merely a question of first cost; it includes the consideration of probable differences in repairs, maintenance, life, efficiency—which, in nearly every case will

clearly demonstrate that the more expensive apparatus is really the cheapest to buy.

It is interesting to note the difference between European and American manufacturing practice, with reference to their respective methods of supplying demands for particular machinery. On this side of the Atlantic all types and sizes are standardized; and manufacturers endeavor not so much to design machinery which will meet the conditions of any particular case, as to show that those particular conditions require the use of such and such a particular machine of their make. That is, the machine is not manufactured for the case, but the case is manipulated to suit the machine. If a 95 horse power machine is sufficient and necessary, the manufacturer who has standardized a 100 h.p. and a 90 h.p. machine will sell his 100 h.p., although it is not only larger than necessary, but also will have to operate at less than full load and therefore at reduced efficiency. In Europe, the manufacturer, not having any rigid standard, would actually design and build a 95 h.p. machine. The standardizing of machinery results, no doubt, in somewhat less shop costs, and in consequent lower selling price, but the disadvantage is evident, when it is considered how very rarely will the circumstances governing the size and type of machinery be such as to exactly meet some particular standard. Of course this disadvantage is largely counterbalanced by the fact that manufacturers' standards include many sizes and types, some or one of which will be pretty certain to come close to the actual requirements. And then again all manufacturers have not the same standards; they will generally be found to be "staggered." If A makes generators of 50 h.p., 100 h.p., 150 h.p., etc.; B will generally make 70 h.p., 120 h.p., 170 h.p.; while C will adopt 60 h.p., 90 h.p., 130 h.p., and so on; so that one can generally come pretty close to what is wanted. The same will apply to motors, etc., but there comes in the question of voltages, etc. However, in every case it will be possible to work out a reasonably satisfactory scheme, if only care and attention be devoted to enquiring what the market has to offer in the way of suitable types and sizes and then selecting those that come nearest to practical requirements. In doing this it should be remembered that the efficiency of machines is a most important consideration, and that, unless they be specially designed differently, their efficiency will be highest at their rated full loads. Taking, for example, a case where study shows that 800 lights is the maximum that can be expected (and there is a very fairly sure proportion between number of inhabitants and number of lights), in this case it would be inadvisable to put in a 1,000 light machine for two very good reasons—first, it is larger than necessary, and therefore needlessly expensive; and second, which is really even more important, it will be operating at never more than 8/10's of full load, and for the very large proportion of the time at very considerably less. Everyone knows that there is a period of large load, say from 7 o'clock to 9 o'clock, and that after that time the people go to bed and the load goes away down. In a plant of the above size, probably for 4 hours the full 800 lights or nearly would be going; and for the whole of the rest of the night not more than 200 or 250; so that if a 1,000 light machine were installed, it would have 80 per cent. load for 4 hours and 20 to 25 per cent. for 8 hours. All the above considerations emphasize the

importance of studying the conditions of every installation, and of buying apparatus with reference to its suitability to the peculiar circumstances.

DEFECTIVE WIRING.

We present herewith a sample of wiring which was recently unearthed in a neighboring city. Our readers will admit that it is a truly wonderful example of how not to do it. Nevertheless it is not altogether an exaggerated case. There has been a vast amount of work of this character done in the past in every city on



this continent. It can scarcely be a matter for surprise that the discovery of such work should have given rise to the suspicion that many of the fires in recent years were the result of stray electric currents.

It is satisfactory to know that the danger resulting from the employment of careless and incompetent workmen has now come to be so well understood that in future proper workmanship is likely to be the rule rather than the exception.

CANADIAN ELECTRICAL STATISTICS.

Mr. Geo. Johnston, the Dominion statistician has collected and embodied in the Year Book of Canada, the following statistics relative to the electrical progress in the Dominion:—The amount of capital invested in electric telegraphs and cables in Canada is \$7,000,000; in electric railways the paid up capital is rather more than \$13,000,000; in electric light works, \$4,113,771; in electrical appliances, \$1,389,365; or in round figures about \$27,000,000. In 1881 there were found only two hands with electric works outside of those connected with telegraphy, while in 1891 there were 1190 hands, not including those connected with the electric cars. The employees in 1894 connected with the electric cars numbered 2614; passengers carried 57,000,000; miles run during 1894 by the electric railways, 15,500,000; miles of track for Canadian electric railways, 368 or 73 miles to each million of the people. The number of motor cars in Canada are calculated as 658; trailers, 341; snowsweepers, 39; and motors, 891. The steam railways in Canada in 1894 carried 14,500,000 passengers, which, contrasted with 57,000,000 carried by the electric railways, shows that four times as many passengers were carried by electricity as by steam, and that, on an average, every person in Canada had been carried 11 times in the year by electricity.

TESTS OF A 10 HORSE-POWER DE LAVAL STEAM TURBINE.*

By Wst. F. M. Goss.

THE De Laval steam turbine experimented upon constitutes part of the permanent equipment of the Engineering Laboratory of Purdue University, and the present paper is based upon data secured chiefly through the assistance of Charles E. Bruff, B.M.E., author of the thesis "Tests of a 10 Horse-Power De Laval Steam Turbine."

In the De Laval steam turbine jets of steam, delivered from suitable nozzles, are made to impinge against the buckets of a light turbine wheel. The steam enters the buckets from one side of the wheel, and passing through is discharged or "exhausted" from the opposite side. The arrangement of nozzle

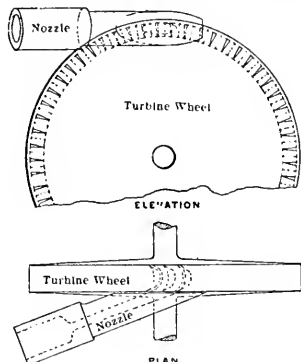


FIG. 1.

and wheel is shown in Fig. 1. The motion of the turbine shaft, which under the action of the jets is extremely rapid, is communicated by gearing to a heavier and slower-moving driving shaft carrying a fly-wheel of small diameter, from which the power of the engine is delivered. Regulation of speed is secured by means of a throttling governor, which controls the pressure of steam admitted to the nozzles.

The important moving parts, with approximate dimensions, are shown in Fig. 2. The turbine wheel is built of sixty-three steel segments, each carrying a bucket and a portion of the light outside rim. The segments are held in place by means of suitable collars, which grip them on either side. The wheel is mounted upon a long, slender shaft, having sufficient flexibility to allow the system at speed to revolve about its centre of gravity, even though this may not agree with the geometrical axis of the shaft. The gear upon the turbine shaft is of steel, solid with the shaft; that upon the drive shaft has its teeth formed in a bronze ring, which is carried by a solid iron centre. The smaller gear has twenty-one teeth, the larger one two hundred and eight teeth, giving a ratio of 1 to 9.90476.

The shafts run in bronze boxes completely lined with babbit or other soft metal. To assist in the distribution of oil a spiral curve, the pitch of which is about half the diameter of the journal, is cut into the metal of the bearing. The outboard bearing on the turbine shaft is closed at the end, and a small pipe runs from the closed end to a point over the gears. The pumping action, resulting from the presence of the spiral oilway, gives a constant, though small, supply of oil upon the gears. The gears do not dip in oil, though the case which encloses them receives drainage from all the bearings.

The governor is connected with the driving shaft, of which, at first sight, it appears to be but an extension. It is shown in detail in Fig. 2. The weights, W W, with their arms, C C, are in the form of a split cylindrical cup. Upon the outside and at the base of each weight a knife edge, E E, is found, which bears upon a suitable surface in the governor frame, A A. A spiral spring is fitted at its inner end with two projecting pins, which bear upon the arms, C C, of the governor weights. The outer end of the spring is connected with the frame by the threaded plug D. When the governor is at rest the concave surfaces of weights are in contact with the frame, and the tension of the spring keeps the knife edges upon their seat. When the governor is revolving at speed the weights are under centrifugal action and move outward, swinging upon their knife edges against the resistance of the spring. The motion of the weights is taken up by

the pin F, by which it is communicated, through suitable mechanism, to the governor valve above the engine.

The nozzles which serve to deliver steam to the wheel are four in number, and are so fixed in the frame of the engine as to act upon the turbine at points which are equally distant from each other. Two of the four are provided with stopcocks, which, when closed, put out of action the nozzles with which they are connected. By means of the stopcocks, therefore, the engine may be run under the action of two, three or four nozzles, at the will of the engineer.

The distinguishing feature of the engine is, perhaps, to be found in the form of the nozzles. All are diverging, the throat being approximately two inches from the discharge end. Three have a diameter of 0.138 inch, and one a diameter of 0.157 inch.

THE TESTS.

The power of the engine was absorbed by a pony brake, cooled by constant streams of water. The exhaust steam was piped to a Wheeler condenser, open to the atmosphere. The water resulting from condensation was drained into tin buckets, which were changed and weighed at regular intervals. Gauges were used to show the steam pressure both above and below the governor throttle, the former giving the pressure available at the engine, and the latter the pressure under which, in consequence of the action of the governor, the steam was admitted to the nozzles. A manometer was also attached to the exhaust pipe, but as this pipe is large (3 inches diameter) and the connection with the condenser close, the observed pressure was never appreciably different from that of the atmosphere.

The boiler pressure for all efficiency tests was 130 pounds by

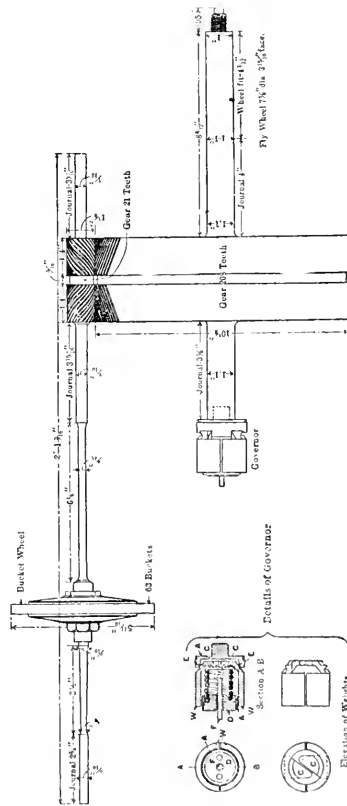


FIG. 2.

gauge, for which pressure the particular nozzles used were designed. The rated speed of the fly-wheel is 2,400 revolutions per minute (23,771 for turbine wheel), but this standard was not maintained for all the tests. The governor was adjusted several times as the work progressed, and it was not until several tests had been run that the proper speed was secured. It is believed, however, that the differences of speed recorded do not materially affect the value of results for purposes of comparison.

The tests are grouped into three series, the first including those for which all four nozzles were in action, the second those

*Abstract of paper read at the New York meeting of the American Society of Mechanical Engineers, December, 1895.

with three, and the third with two. The several tests in each series were intended to vary from each other only in amount of power delivered from the wheel. All tests were of 30 minutes' duration, and all observations were taken at five-minute intervals.

With all four nozzles in action, and with the engine developing a little more than its rated power, the steam consumption per horse-power hour was as low as 47.8 pounds. In comparing this result with results obtained from other engines, the small size of the engine tested should be kept in mind, and also the fact that the rate of consumption stated is based upon brake power. The efficiency of the engine falls off rapidly as the load is decreased, and, as would be expected, the effect is not marked when all the nozzles are in action. This may best be seen by the heavy curves shown in Fig. 3. Assuming the nozzles to be cut out of action

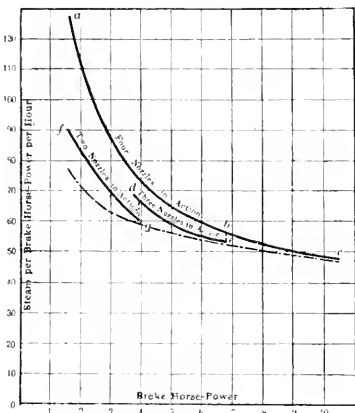


FIG. 3.

one at a time, as soon as the reduction of load becomes sufficient to permit the work to be done without them, the minimum steam consumption at different loads, for boiler pressure and speed employed, is represented by the broken line fgdebe, Fig. 3. Again, if instead of four nozzles, an infinite number could be employed, and if the governor could be arranged so as to regulate the number in action rather than the pressure admitted to them, the steam consumption of the engine in question might be made to follow a line somewhat similar to the light broken line g e c. But the heavy lines indicate the results which were actually obtained.

The engine requires very little attention and is almost noiseless in action. The governor is quick to act, and its speed regulation appears to be fair, except when changes of load are large and suddenly made. After such a change, the engine requires a little time before settling down to steady running under the new conditions.

As the speed of the De Laval engine is high, it is evident that the force in action must be comparatively low. To determine the maximum resistance under which the engine might be expected to start, the brake was clamped upon the fly-wheel so that the latter could not turn within it. Steam was then admitted to the engine, and readings were taken from the scale under the brake arm. The result of this process, of course, depends upon the steam pressure and the number of nozzles in action. With all nozzles, and with a steam pressure of about 125 pounds by gauge, the maximum starting-power is equal to a force of 30 pounds acting at a radius of one foot. With three nozzles the equivalent force was but 21 pounds; with two nozzles 14 pounds.

In the case of the Ontario Western Lumber Co. v. Citizens Telephone and Electric Co., Chief Justice Meredith decided that contracts not under the corporate seal made with trading corporations relating to purposes for which they are incorporated, or, partly performed and of such a nature as would induce the Court to decree specific performance thereof if made between ordinary individuals, will be enforced against them. Where, therefore, an electric light company, while they were making changes in their factory, entered into a contract by correspondence, merely for the use at a specified amount, of one of the wheels in the plaintiffs' mill which was used and a part payment made the contract was held to be binding on it, and the plaintiffs entitled to recover the balance due, notwithstanding the absence of the corporate seal.

ENGINEERING NOTES.

AN engine may appear to be keyed up all right, and still, when it is started up, the crank pin or some other part may heat because the key was driven too far, therefore all of the parts should be closely watched until it is known that they will run cool.

To ascertain the throw of an eccentric, measure the distance from the crank shaft to the outside of the eccentric on the heavy side and also on the light side. Subtract one from the other, and the difference will be the throw of the eccentric.

If you have a bearing so located that it is necessary to have a tube or pipe to carry the oil to it, be sure that the tube is perfectly clean when first put in, and take measures to keep it so after it is in use.

Always have a steam gauge on the feed-water pipe, and locate it as near the pump as may be convenient. If the pipe becomes partially choked with sediment, the increase in pressure will warn you of it.

Don't put a poor lubricator on a good engine, or on a poor one either. It will ruin the good one by failing to deliver oil when it is needed, and make the poor one worse for the same reason.

Try the nuts on your foundation bolts occasionally and see if they are still tight. Because they were all right six months ago, it does not necessarily follow that they are now.

After cleaning your boilers fill them with hot water if possible. If one of them is fired up, use the steam from that one to heat the water that is going into the others.

When water has a temperature of 39 degrees Fahrenheit, it has attained its maximum density, or in other words, it is in its most compact form. If you make it warmer it expands and if you make it colder it also expands. A study of some of the results of this property of water will prove interesting.

When fitting up a water tank for use in the shop, mill or factory, if you wish to arrange it so that the discharge pipe will prove the most efficient, do not allow it to project on the inside, but let it be so arranged that there will be no sharp corners around the outlet, for it should be funnel shaped.

When about to key up his engine, an engineer should know just where his keys are before he touches them, and in order to do this he must have marks on them. If these marks are made with a sharp steel scribe they disfigure the machine and in the course of time he will get so many marks that they will be confusing. It is much better to mark them with a lead pencil, then if he finds that a key has been driven too far he can easily put it back to its former position, and when the machine is running in a satisfactory way the marks can easily be removed.

Many engines are so constructed that the space around the piston rod gland is quite small, and so we would suggest that a short solid wrench be made for use in such cases, and always be kept in a convenient place. As it is seldom or never necessary to use much leverage here, a large one will not be needed and it will be much more convenient than to try to use an ordinary monkey wrench.

In some cases it is necessary, in oiling up an engine, to drop oil into a tube in order to have it go where it is needed. Sometimes this cannot be done easily, as a bubble will form and prevent it. In such a case, insert a piece of fine wire or a broom splinter in the tube, and the oil will run down this and cause no trouble.

In selecting a lubricator for a steam engine it is well to get one that is so constructed that when it must be filled, the cylinder oil will go directly into the cup, without having to go through a long crooked passage, for many good oils are thick and it is not always convenient to warm an oil before using it.

If the sight feed glass on your lubricator fills with oil, and it is so constructed that you cannot easily clean it out, if the oil is removed from the body of the cup and it is filled with water and started up in the usual way, the water will float the oil out without further trouble.

Remember that if your eccentric gets cut and is worn out or round so that it becomes necessary to put it in a lathe and take one or two cuts off from it, the reduction in diameter does not alter the throw of it.

In our opinion it is better to key up an engine in the morning rather than at night. If it is done at night, what proof does the engineer have that he will be there to attend to it the next morning?

Every piston rod gland should be lined with soft brass to prevent cutting of the piston rod.—Power and Transmission.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

For the past two weeks the examinations at the Toronto Technical School have been in progress, the term closing on the 1st of May. The classes during the past winter have been very successful, a large number of students availing themselves of the opportunity thus afforded of securing a technical education. Below will be found a copy of the examination papers in "Electricity" and "Steam and the Steam Engine," which will no doubt prove interesting to many of our readers. The lecturer on these subjects is Mr. James Milne, who, it will be observed, has covered considerable ground, and the results of the examination are said to be satisfactory. In our next issue we hope to be able to publish correct answers to the questions asked in the following papers:

ELECTRICITY.

Maximum number of marks = 235. 175 marks constitute a full paper.

The value of each is shown in brackets after the question.

SECTION 1.

1. State clearly Ohm's Law. What is the unit of resistance? the unit of Current? and the unit of Electro-motive force? (10)
2. A battery of 15 cells, arranged five in series and 3 abreast, produces a current of .5 amperes through an external R of 5 ohms. Find the E M F of each cell if its internal R is 3 ohms. (15)
3. What is the best way of arranging 28 cells, each having an R of 4 ohms, so as to produce the strongest current in a circuit of 28 ohms. (15)
4. Compare the resistances of a wire 30' long, .06" diameter, and that of another wire 15' long and .03" diameter. (10)

SECTION 2.

1. 1000 feet of copper wire .102" diameter is wound on an armature of a bipolar generator. Find (1) the total resistance of that wire, and (2) the resistance as measured at the brushes of the machine. One mil foot = 10.4 ohms. (15)
2. Take the above question but substitute iron wire. What is the thickness so that the resistance will be the same in each case? The specific resistance of copper to that of iron is as 1 : 6. (10)
3. Prove that 746 watts make a H. P. Answer this fully. (15)
4. 1000 feet of wire No. 6 B and S has a resistance of .4 ohms. Find the watts lost in an arc light circuit 5 miles long. Each lamp takes 10 amperes of current. (10)

SECTION 3.

1. The E.M.F. of a certain dynamo machine is 100 volts, and the total R of the circuit is 1 ohm. What H.P. would have to be expended in working under these conditions? (10)
2. Distinguish between work and power. What is the unit of each? What is the British heat unit [772 ft. pounds] equivalent to in electrical units of power? (10)
3. Describe fully the Edison Chemical meter, knowing that 1 ampere passing for 1 hour between zinc plate immersed in a solution of salt of that metal will remove from 1 plate and deposit 1225 milligrams on the other. What would be the amount of current that would pass in the above meter if the resistance of the German silver shunt was .02 ohms, and the resistance of the other circuit in which the zinc voltmeter of 2.5 ohms is inserted in series with another R of 46.46 ohms, if the deposit was 200 milligrams? Make a sketch of the arrangement. (20)

SECTION 4.

1. Describe the Wheatstone's bridge as fully as you can, and illustrate the application of the instrument by an example. (10)
2. How are very high resistances measured? A galvanometer of 6000 ohms shows a deflection of 10 when a certain resistance is in circuit with it. Knowing that the same galvanometer shows the same deflection with a resistance of 1-10th megohm in circuit when shunted with a 1-10th shunt, find this certain resistance. The resistance of the battery is neglected. (15)
3. An ammeter is simply a galvanometer of low resistance, and is generally placed in series in a circuit. What would be the effect if you placed this meter in multiple, say on an incandescent lighting circuit; and also if you had placed a voltmeter (a galvanometer of high R) in series in a circuit carrying large currents. (15)
4. Make a diagram showing clearly the connections on a shunt wound dynamo, placing in the circuit a voltmeter and ampere meter. (10)

SECTION 5.

1. Show by a diagram the general arrangement and connections of generators running on a 3-wire system. Show by an arrow the direction of the currents if (1) both machines are doing exactly the same amount of work; (2) if one machine is doing more than the other. Place in position ampere and voltmeters. (15)
2. 886,000 lines of force (N) are to be forced through a bar 20" long and 8 sq. inches in area. Find the reluctance and the magnetizing force in ampere turns to effect this magnetization. Permeability = 160. (15)
3. In a generator which is driven by a 100 H.P. engine, belt speed 5,000 ft. per minute, there are 200 conductors in the armature winding 100 sections in commutator, the gap is .45. Find the tongue and the drag on the active conductors. (15)

STEAM AND THE STEAM ENGINE.

120 marks constitute a full paper.

1. What is the latent heat of steam at 212° Fah., expressed in foot pounds? What is the difference between latent and sensible heat? If one pound of steam at 212° Fah. is mixed with 10 lbs. of water at 60° Fah., find the resulting temperature. (15)
2. Steam expands in the cylinder of an engine from 30 lbs. pressure above atmosphere to 5 lbs. below atmosphere, at what part of the stroke was the steam cut off? Atmospheric pressure may be taken at 15 lbs. (15)
3. Define the lap of a slide valve, and explain answer by reference to a sketch. For what purpose is it employed? Account for the difference in the working of two engines, one of which has lap on the steam side of the valve and the other has not. (15)
4. Describe Savary's engine. Show by a sketch the principle on which it worked. What was the greatest depth the water could be lifted by this engine? Why was it limited to this extent? (15)
5. The diameter of a steam engine is 24", and revs. per minute = 60. M. E. P. = 40 lbs. What should the length of the stroke be so that the engine will develop 330 H.P. (15)
6. Sketch Newcomen's engine. During what portion of each stroke, and in what manner was unnecessarily wasted by Newcomen's arrangement? How did Watt propose to lessen this waste, and in what way did he carry out his idea? (15)
7. What is meant by the term "clearance" and "cushioning"? At what part of the stroke does cushioning occur? Show by an indicator diagram the manner in which the slide valve produces cushioning. (15)
8. Describe Stephenson's Link motion. How is an engine reversed by this arrangement? Make a sketch to illustrate. How would you arrange a link motion with one eccentric only? What is shortening the travel of the valve equivalent to? (20)
9. A safety valve 3" diameter is held down by a lever weight. Lever 36" long. The valve centre is 4" from the fulcrum. Weight 50 lbs. Omitting the weight of lever and valve, at what pressure would the valve be lifted? (15)
10. Show the various methods of connecting the heads of tubular boilers to the sheets. What are the relative strengths of a single and double rivetted lap joint to that of the original plate? (15)
11. You have two engines exactly the same size; one has steam cut off at $\frac{1}{4}$ stroke, the other has steam cut off at full stroke. Show by calculation what is gained by using the steam expansively. (20)
12. Describe as fully as you can the Hydraulic Ram. Show the arrangement by a sketch. (15)
13. A hydraulic ram has an efficiency of 70. 40 gallons of water are spent on same, with a fall of 10 feet. How many gallons will it raise to a height of 400'? What is the pressure at the bottom of a column of water 400' high? (15)

The force of a stroke of lightning in horse power is indicated by the following incident: During a recent storm which passed over Klausthal, Germany, a bolt struck a wooden column in a dwelling, and in the top of this column were two wire nails 5-32 inch diameter. The two nails melted instantly. To melt iron in this short time would be impossible in the largest furnace now in existence, and it could only be accomplished with the aid of electricity, but a current of 200 amperes and a potential of 20,000 volts would be necessary. This electric force for one second represents 5,000 horse power, but as the lightning accomplished the melting in considerably less time, say 1-100 of a second, it follows that the bolt was of 50,000 horse power.

THE DAKE ENGINE.

The extremely compact type of engine shown in the accompanying illustrations is unusually interesting on account of the ingenious mechanical principles involved in its design. As a steam engine, aside from questions of design, the manufacturers claim that experience has demonstrated that in reliability, and especially durability, it is not exceeded by any of the types of usual design. On account of its compact form, this engine is claimed

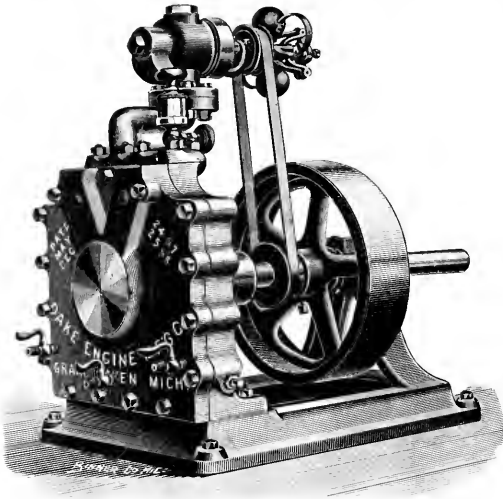


FIG. 1.—DAKE STATIONARY ENGINE.

to be particularly suited for running ventilating fans, centrifugal pumps, incandescent lighting dynamos and saw mill carriages. Being strongly built, self-contained, and not affected by ordinary jars, it also gives reliable service when used to run smoke-consumers and head-light or other dynamos on railway trains, and when employed for various auxiliary purposes aboard vessels.

Fig. 1 illustrates the engine complete, and in Fig. 2 the pistons are removed, showing the interior of the case with the crank in position, this latter revolving in the chamber shown in the back of the case in the central cut. This chamber is supplied with oil and water from an opening in its back, thus securing lubrication to every part of the interior of the engine.

Both side pistons have a horizontal movement sliding from side to side, and at the same time an inner piston to which the crank pin is attached has a vertical or up and down motion, the two movements imparting rotary motion to the crank. Steam is admitted through channels in the cover, one opening into a central aperture and another into an annular opening on the inside of the cover. Four channels are cored through the inner piston, one leading to the top and another to the bottom, and one to each end of the inner piston, the latter also leading through the ends of the outer piston. Four parts corresponding with the channels in the interior of the inner piston are cut through the face (or side next to the cover) of the inner piston in the proper position to register over the central aperture in the cover. The steam entering the port in the inner piston, through the central aperture of cover and re-acting against the side of the case, imparts motion to the crank, the port passing over the annular ring and exhausting into it after having done its work. There are four distinct impulses of steam to

each revolution of the crank, and the arrangement of the ports to the crank are such that each impulse of steam is given at a point where it has the greatest power. The expansion of steam is secured in the passage of the ports of the inner piston over the central aperture in the cover.

With the reversing engine, the channelling on the cover and in the piston is the same as in the engine built to run one way, but the ports in the inner piston are shaped so that they register over both the central and the annular openings, using each alternately as steam and exhaust. The ports on the top of the case being fitted with a suitable valve which connects the channels leading to the working parts of the engine, motion is given to the engine either to the right or left, as desired. The reversing engine is the same as a

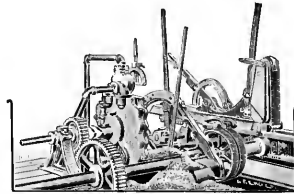


FIG. 3.—CARRIAGE ENGINE.

stationary engine, only with reversing throttle instead of governor.

Provision is made for taking up the wear of the working parts of the engine in a simple and effective manner. The inner piston is fitted with phosphor-bronze slides that admit of a thin piece of tin or sheet iron being inserted when the wear is sufficient to allow it. A wedge-shaped plate on which the lower slide rests is arranged with set screws on the outside of the case (Fig. 2), which keeps the piston steam tight, top and bottom. The packing of the cover to the pistons is effected by thin copper joints placed between the edge of the case and cover. The pistons are made so that they are slightly thicker than the case they occupy, and enough copper strips are put in to fill up the space; these joints are removed one at a time as the pistons wear down, and where it is seen that repacking is needed and a copper joint is too much to take off at one time, a piece of thin paper to take its place will repack the cover perfectly. The repacking of the cover as above described, and replacing the nuts or cap screws (as found

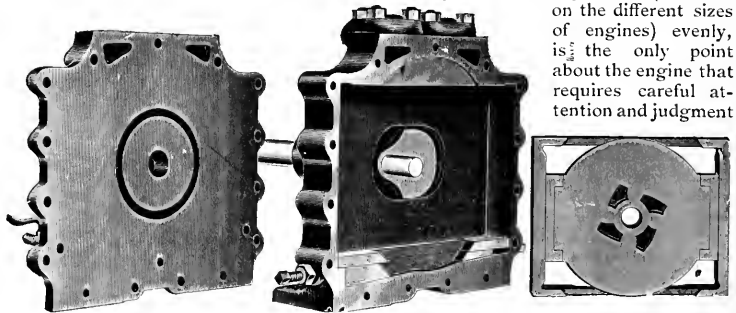


FIG. 2.—DAKE ENGINE, SHOWING PISTON WITH CYLINDER COVER REMOVED.

on the part of the person in charge, and repacking is not required except at long intervals.

There is very little friction, and consequently slight wear on the pistons, from the fact that the steam pressure is inside of the inner piston, instead of against it, making the pistons similar to balanced valves. The bearings for the main shaft and crank pin are in the form of bushings and made from phosphor-bronze. From the manner in which steam is applied to the pistons the wear is slight compared with the ordinary engine. When they need renewing the worn ones are driven out and the new bushings driven to place, which can be done by any good machinist at a small cost to the purchaser. The crank and pin are made from the best quality of cast steel, and the shaft, which is ma-

on the different sizes of engines) evenly, is the only point about the engine that requires careful attention and judgment

chinery steel, is shrunk into the crank in a solid manner. The outer piston is also made from best quality of cast steel. Every part of the interior of the engine is fitted with the greatest care. The inner face of the cover and all of the working parts of the engine are ground surfaces, made with tools especially designed for the manufacture of this type of engine, thus ensuring that the engine is practically steam tight from the start. Everything about the inside of the engine is made interchangeable, and can be duplicated in case of accident on short notice.

Fig. 3 shows the carriage engine for setting up and receding head blocks.

In Fig. 4 is shown the steam feed, which is recom-

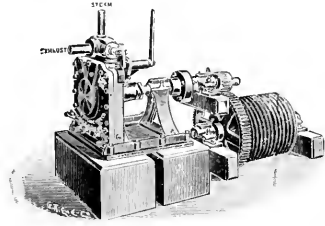


FIG. 4.—STEAM FEED.

mended to the consideration of saw mill owners and operators. The claims made for it are simplicity of construction, positive operation and easy management, economical use of steam, small space occupied, cheapness, and easy adaptation to either new mills or those now in use. In placing the engine in position, it is not necessary to move the husk frame, as it can be lowered from above through the frame onto foundation. The movement of the engine in either direction is under absolute control of the sawyer by lever connecting with reverse valves on top of engine, thus accommodating

the speed of the feed to the size and conditions of logs.

The Duke engine has been placed upon the Canadian market by the Phelps Machine Co., of Eastman, Que., who will gladly furnish any further information.

SPARKS.

The town of Magog, Que., is inviting tenders for electric street lighting.

An incandescent plant will be installed by Hewson Bros., of Durham, Ont.

The ratepayers of Alexandria Bay, Ont. have voted \$1,000 per year for electric light.

The electric light plant at Three Rivers, Que., is offered for sale by tender. The date limit is the 15th inst.

Mr. W. H. Pearson, of Toronto, manager of the Trenton Electric Co. is seeking a franchise for electric lighting in the city of Belleville.

The Toronto Electrical Works, Toronto, suffered damage by fire recently to the extent of \$2,500. Considerable valuable machinery was destroyed.

The town of Orillia, Ont., will likely enter into an agreement with Mr. Tait to furnish incandescent lights on the present dual basis for five years from January 1st, 1895.

The city engineer of St. Thomas, Ont., has been instructed to prepare an estimate of the cost of constructing an electric plant to supply heat, light and power and to operate an electric railway.

The city of Vancouver, B. C., has accepted the proposition of the Consolidated Tramway and Lighting Company to light the city, at 27 1/2 cts. per light for 200 lights, or 27 cents for over 200 lights.

The Canadian General Electric Co. are placing an electric light plant for the town of Niagara Falls, Ont., including two dynamos with a capacity of 5,000 lights, together with two engines of 535 horse power.

Mr. A. W. White, London, Ont., has been appointed one of the umpires on the Cosmopolitan motorcycle race in New York, to be held on May 30th next. Mr. White, it will be remembered, was umpire on the Duryea motor, which won the motorcycle race at Chicago.

R. McGowan has purchased from the Johnston Electric Company a 1,000 light alternator and equipments for 1,000 incandescent lights for Durham, Ont., where he has an arc plant at present. He also owns the electric light plant at Oakville, Ont. The installation work in connection with the new plant at Durham will be carried out under the direction of Mr. R. McGowan, jr., of Oakville.

Canadian General Electric Co., Ltd.

Authorized Capital, \$2,000,000. | Paid up Capital, \$1,500,000.

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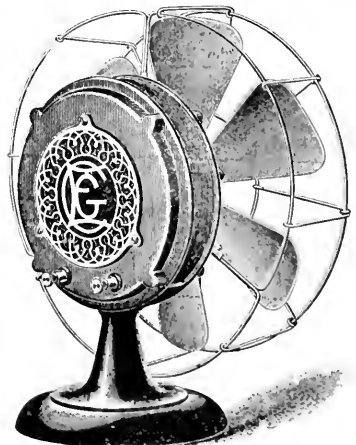
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ELECTRIC RAILWAY DEPARTMENT.

THE MONTREAL PARK AND ISLAND RAILWAY.

THE Montreal Park & Island Railway was incorporated in 1885 by Statute of Quebec. At subsequent dates, viz., in 1886 and 1893, amendments to the original charter were passed by the Quebec Legislature, and in 1894 the railway was declared for the general advantage of Canada, and came under the jurisdiction



FIG. 1.—THE MARPLE RAIL BOND.

of the Federal Parliament. New powers were then granted the company, and in 1896, during the last sitting of Parliament, further powers were obtained, and the company now is in a position to complete the construction of the various electric railways contemplated.

Of the gentlemen who were originally instrumental in bringing forward this project, Hon. J. R. Thibaut, Sheriff of Montreal; Mr. Henry Hogan, the well-known proprietor of St. Lawrence Hall, Montreal, and Hon. Louis Beaubien, are at present directors of the company.

The first construction undertaken was the line through Mile-End, to reach the River des Prairies, and thence down the right bank of the river to Sault au Recollet

around the two mountains, and furnishing a line of communication for many outlying municipalities which will tend to develop them at a very rapid rate. Not only this, but it furnishes for the people of Montreal a most delightful trip during summer, which they are not slow to avail themselves of, and on pleasant afternoons and Sundays the company's resources are taxed to provide sufficient accommodation to carry the thousands of people who go out to spend a half hour in riding over the lines, which affords an opportunity of looking at some of the finest scenery of which this country can boast.

During the present season the Company expects to complete its system. Among other lines, they will build to Lachine and to Bord'a Plouffe by way of St.

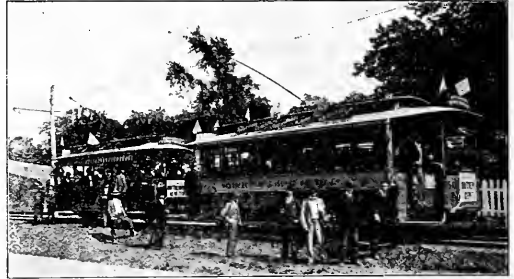


FIG. 3.—TWO CARS ON THE OUTREMONT DIVISION.

Laurent, in addition to the already mentioned extension to St. Vincent de Paul.

The mileage of track at present operated is 22, and by the end of the year the length of track operated will be in the neighborhood of 50.

From the peculiar development of Montreal, being as it is so densely populated in certain districts, it is evident that the opportunity for developing suburban business is considerable. The population being concentrated, the necessity for moving out becomes more apparent every year as the necessities arise for factories and business houses occupying sites in the older residential portions of the city, gradually forcing the residents further away where they can secure fresh air and more room.

The building of a suburban electric system affords every opportunity for the people improving their condition, and although the people of the working class of Montreal are very conservative in their ways of living, yet they are beginning to be convinced of the desirability of changing their places of residence from the

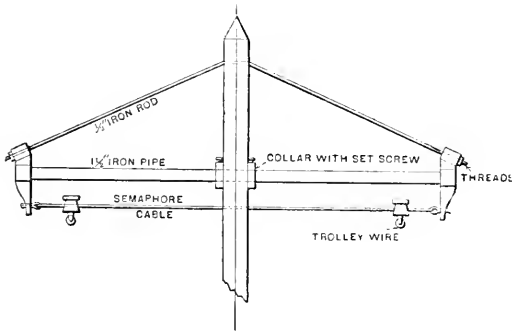


FIG. 2.—DOUBLE BRACKET CONSTRUCTION.

Village. This was built in 1893. This line, like nearly all suburban lines, has had the usual pioneering difficulties to overcome, and as the proprietors of the road determined to make the project a successful one, they persevered with the work and they have succeeded in putting this line in good condition, both physically and financially.

This piece of track, commonly known as the Back River line, extends for nearly 7 miles from the city limits. It is double track from the city limits to the Shamrock grounds, from which latter point it is single track to the terminus. It is the company's intention to extend this line about four miles farther in order to reach St. Vincent de Paul. This work will probably be commenced during the current year.

In 1894 a double track line was built from the city limits at Mount Royal Avenue around the mountain through Outremont as far as Cote des Neiges Road, thus reaching the cemeteries. In 1895 this line was continued around the western mountain to the westerly limit of Westmount, connecting there with the Montreal Street Railway, Sherbrooke Street line, thus completing a double track electric circuit 11 miles long



FIG. 4.—BACK RIVER STATION.

smoky, unhealthy portion of the old town to the delightful country surrounding the city, to say nothing of the reduced cost of living, and this is all made easily possible by the Montreal Park & Island Railway Company, which has persevered in preaching this doctrine to a most conservative community.

By an arrangement existing with the Montreal Street Railway the cars of "Park & Island" system come over the tracks of the street railway to the centre of the city, the street railway having the benefit of the cars for their purposes on their lines in going to and from the city limits, and the passengers to and from the suburbs thus not having the necessity to change cars.

ROADWAY.

The track is laid throughout with 56 lb. Cammell steel rails of Sandberg section. The joints are four bolt angle bars, and the track is laid with broken joints, except in street work, where the joints are square. The roadbed is built up high wherever it can be built. Ballast of broken stone, gravel and cinders are used according to circumstances. The bond is of No. 6 soft copper wire, soldered to a brass plug, which is pressed through a drilled hole in the web of the rail.

OVERHEAD CONSTRUCTION.

This is on the general plan of the "west end," though malleable iron parts are being substituted for bronze. The hangers are attached to cable supports both in bracket and span construction in order to provide flexibility. The ears are for the most part soldered, but a mechanical clip will in future be used instead. The trolley wire is No. 6 hard drawn wire. The posts are cedar 8 inches diameter at top.

POWER PLANT.

This consists of an installation of steam engines driving two generators, one of 200 k. w. and one of 100 k. w. capacity, made by the Royal Electric Company, of Montreal. The power station, however, is but a temporary installation, and a description of the permanent power station will appear in a future number. The construction of the new plant will soon be commenced.

ROLLING STOCK.

This consists of twenty motor cars, ten of which are closed cars, six are nine-bench open cars, and four are thirteen-bench double truck motor cars, 38 feet over all. In addition to these above there are four open trailer cars. The motors are for the most part of the "Royal 30" type, made by the Royal Electric Co., of Montreal, and the severe tests that these motors were put through during the extraordinary severe winter of February and March of this year, as well as on previous occasions, justify very high praise for the Royal Electric Company. The motors are mechanically excellent, and electrically they are highly efficient. For heavy or light work these motors are very satisfactory. The small truck which has given the greatest satisfaction is that made by the Canada Switch and Spring Co. The double trucks are all of Brill No. 23 pattern.

TELEPHONES AND SIGNALS.

The lines are equipped with telephones, and connecting wires are led down the posts at close intervals, the telephone instrument being portable and merely hooked to the contacts on the posts, so that connection may be had with head office from any point of the line. Each regular car carries a telephone.

On single track lines the Skeen signal system is being installed, and will be used no doubt on other single track lines to be built, as it enables a maximum number of cars being operated on a single track.

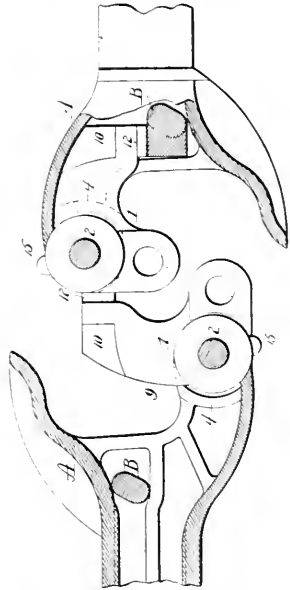
The officers of the company are:—Hon. Louis Beaubien, President; Hon. J. R. Thibaudeau, Vice-President; Henry Holgate, manager and engineer.

Mr. Holgate was from 1878 to 1888 connected with the Northern and Northwestern Railways, and upon those railways uniting with the Grand Trunk Railway in 1888, he continued in his former capacity as chief engineer of the division until 1893, assuming his present position in June, 1895.

A more complete description of the Park and Island system will be given in a future number, when the new work becomes sufficiently advanced.

IMPROVED AUTOMATIC CAR COUPLER.

RAILWAYS to-day demand an automatic coupler that is strong, cheap, reliable, decisive in its action, self-adjustable and interchangeable with the present rolling stock of the world. At an exhibition held in the Park Avenue Hotel, in the city of New York, attended by the railway managers of the amalgamated roads of the United States, the invention of Otto Flohr, of which we give an illustration, was unanimously voted as being the only invention of its kind worthy of consideration from all points ethical and economic. The chief advantage of this device in the eyes of practical railway men are that the couplers are interchangeable with any of the vertical plane couplers now in use; absolutely automatic; simple in construction; undoubtedly cheap; certain in action; durable; can be handled with ease



IMPROVED AUTOMATIC CAR COUPLER.

and without hanger, and will lock on a curve as readily as on a straight line.

The coupling obviates the necessity of any one going between the cars and the parts are so ingeniously constructed that the resistance in uncoupling is reduced to a minimum. The locking arm rises automatically by being pressed by the locking arm, which has a slight taper at the end, which engages with an incline face upon the pin, forcing the pin up during the concussion until the arm swings by and clears it.

The knuckle swings open the moment the pin is released, as the result of its own gravity it resting on the highest point of resistance on a spiral-way, when closed from which it naturally descends from its own weight. The outer edge of the knuckle has a stop that prevents the possibility of the locking arm swinging out too far to be of service.

It is a coupler that is wonderfully clever in its mechanism and is entirely different to any now in use. Patents have been granted in Canada, United States, England, France, Belgium and Russia. The Dominion Government passed a bill last session that if enforced will cause all railways in Canada to adopt within two years some such automatic coupler.

The Winnipeg Electric Street Railway Company have in connection with their road two parks situated about four miles from the centre of the city. In River park they have a half-mile race track, large grand stand, bicycle track, field for lacrosse and such sports, roller skating rink, etc. Elm park is situated just across the river from River park, and is reached by a pontoon bridge. It also contains the necessary requirements for a pleasure resort, and being thickly studded with trees, is used largely by picnic parties. The traffic to these parks in the summer is very large, and they are considered excellent investments.

Col. John Stacey has purchased the franchise of the St. Thomas Street Railway Co. from Messrs. Cameron & Hunt, of London. It is proposed to electrify the system.

PIONEER ELECTRIC RAILWAY WORK IN CANADA.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR, I observe in your March issue a letter from Mr. James W. Easton, in which he claims that the first successful attempt in Canada to propel cars by electricity was made in 1883 on the Industrial Exhibition grounds at Toronto, the motor and power equipment consisting of three old Ball machines designed for are lighting. Inasmuch as Mr. Easton admits that the efforts of a couple of men were required to push the empty car up the grade, and that no passengers could be carried, I think it is tolerably clear that so far as practical results are concerned, the experiments referred to cannot be considered to have been successful. I am informed by persons who witnessed the experiments that the only way the cars would run was down hill.

Very truly yours,

OLD TIMER.

Directors of the Sherbrooke, Que., Street Railway Company have been elected as follows: Walter Blue, Wm. Morris, J. W. Burke, J. E. Flood and F. J. Griffith. Mr. Burke has been elected president, and Mr. Griffith, secretary.

The Rathbun Company, of Deseronto, are now building an electric self-loading street car for A. Jackson Reynolds & Co., of Montreal, which, it is claimed, will revolutionize street cleaning in all towns and cities. One car, it is said, will clean 25 miles per day and take the sweepings out of the municipality at a saving of 60 per cent.

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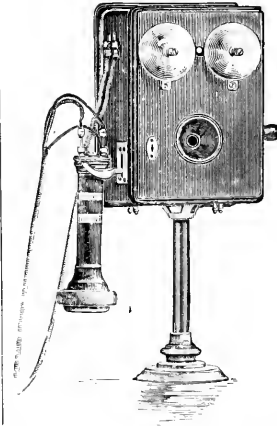
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... TO ...

Central Station Men

Read Extract from letter from another
Central Station Man who saved money
by consulting me ❀ ❀ ❀



DEAR SIR : I am glad I had you to inspect my electric plant. I had thought the expense of such an inspection by an independent man would be money wasted. You have convinced me I can save far more than your fees cost me, and in directions an inexperienced man would never think of. I think no person should do business with electric companies without securing the advice of an independent engineer, as he can save far more than he costs, and get better work done.

Yours truly,

— ELECTRIC CO.

The original of the above may be seen at office

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18 Imperial Loan Building, TORONTO

Consulting Electrical Engineer

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL.

VOL. VI.

JUNE, 1896

No. 6.

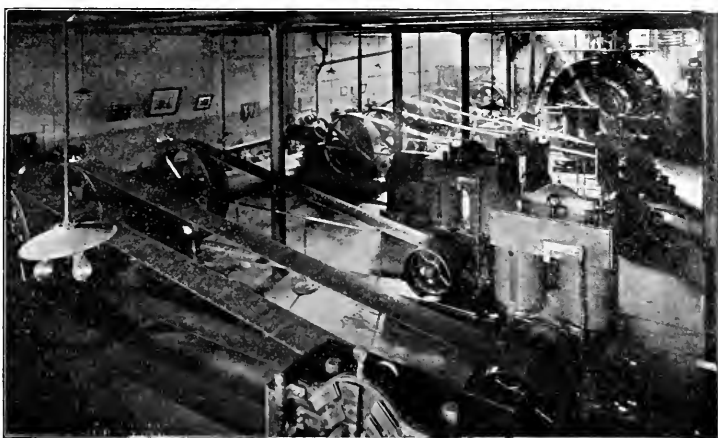
THE ELECTRIC LIGHT INSPECTION ACT.

REFERENCE was made in the May number of the ELECTRICAL NEWS to complaints regarding the operation of the Government Electric Light Inspection Act. Pursuant to the promise then given, further inquiry has been made, the result of which shows the system of government inspection to be extremely unpopular with the electric lighting companies throughout Canada. The large number of such companies who have written us their opinions on the subject take the ground that a system of compulsory inspection by the government is unnecessary, and that no equivalent is given either the

Has the inspection been productive of any better understanding between seller and buyer?.....
Are the consumers more satisfied with their bills now than they were prior to the date when the inspection system went into operation?.....
What is your experience of the performance of direct current mechanical meters with commutators, after being sealed up by the government seal? Do you find them slow?.....
What is your general opinion as to the advisability of government interference between buyer and seller? Would you consider the competition between different methods of lighting a sufficient safeguard of the interests of the consumer even in places where there is no gas, where the ideas of the community are about the size of a coal oil lamp, and where electricity has of necessity to be sold cheaply enough to be an inducement for its adoption?
Remarks:.....

C. H. MORTIMER, Publisher.

The large number of replies received to the above in-



ENGINE AND DYNAMO ROOM, INCANDESCENT STATION, TORONTO ELECTRIC LIGHT CO.

companies or their customers for the yearly fee which the former are compelled to pay the government. Companies doing a limited business in competition with coal oil in small towns and villages are especially bitter in their complaint of the uselessness and injustice of the system.

With the object of eliciting an expression of views upon the subject, a copy of the following circular was recently mailed to the electric companies throughout the Dominion :

OFFICE OF
CANADIAN ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

Confederation Life Building,
TORONTO, May 1st, 1896.

DEAR SIRS:— Having lately heard some dissatisfaction expressed with the system of electric light inspection put in operation last year by the Dominion Government, I would feel obliged if you would kindly favor me with your opinion, on the line of the undermentioned inquiries, as to the extent to which you consider the operation of the system advantageous and satisfactory.

In case it is found to be defective and burdensome on the companies, the ELECTRICAL NEWS will endeavor to have it improved or abolished.

What is your opinion of the present system of government inspection of electric light? (a) Is it an advantage to the seller?.....
(b) Is it an advantage to the consumer?.....

Is the annual inspection fee in your opinion a fair one?.....

quiries, and the very decided language employed in expressing disapproval of the inspection system, are, as already stated, evidence of the widespread feeling of indignation which prevails as a result of the injustice to which the lighting companies feel they are being subjected. In order that the Inspection Department may see exactly the condition of affairs, we print verbatim the following opinions:—

"Our opinion is there is no necessity for such interference."—
St. Marys, Ont., E. L. Co.

"The Government have no right to interfere, as there is not the slightest call for such. Government inspectors are not educated for their position. Should any company be in opposition to the government, the officials could injure their business. Have already expressed our views very strongly to ministers of the crown in opposition to the system of inspection. Nothing less than an imposition."—
Kemptville, Ont., E. L. Co.

"(a) Yes, if we could induce our customers to adopt it. (b) No, not when compared with a flat rate. Its an unfair tax for which no benefit is given. There is no gas here, but we find we have to compete against the cost of coal oil, and this necessarily keeps the price down or we could not get the business. This appears to us to be sufficient security to the consumer. When the price is

not satisfactory they cannot be compelled to use electric light."—Citizens Telephone & Electric Co., Rat Portage.

"The biggest fraud on earth—an advantage to no one. Never saw the inspector; has never been here. We do not use meters at all. Rent by the year, and consumers use as much current as they want. Do not approve of government interference at all. Believe this law was made more for the purpose of furnishing some hungry politician with an easy and lucrative position than for any benefit it might confer on either buyer or seller. It is the biggest farce we know of."—Cayuga, Ont., Lt. & Power Co.

"We consider this inspection fee one of the most unfair things that was ever adopted. If we took money from any person without giving him an equivalent better than what we get for this inspection fee, we would feel that we had stolen the money. The inspector came and said, 'I want \$25.00; I don't know anything about the electric plants, but I must have the money.' So he got it, and that is the last we have seen of the thing and is likely to be until they want more. It does not do any good in small places at least; it is too bad. Kindly do what you can to have it abolished altogether."—

"We have been expecting inspection of meters for the past year, but have not got it yet; cannot say whether same will be satisfactory. The fee is not a fair one—it is altogether too high. The competition in the lighting business is in most places very keen, and there is no danger of the public being overcharged for light. A meter of any kind is by the consumer generally considered an unreliable machine, and as one of those having to do business by meters, we think the inspection by government a good thing to fall back upon, and will to some extent satisfy the consumers."—People's Electric Co., Windsor, Ont."

"(a) (No, we run all flat rates.) We get no value. Have never seen or heard from inspectors except to collect fee. Where current is sold by meters, and meters are inspected and value given by inspectors for work done, there is some excuse for collecting an annual fee, but it is certainly a hardship to be compelled to pay a fee to a department which is of no earthly use in any manner or form. This applies to all stations selling current on flat rate basis."—Gananoque E. L. & Water Supply Co.

"I do not think the government should interfere. It seems to me to be only a scheme to raise revenue, as we have paid \$25.00 for a registration fee and so far have had no inspection, nor do we know who the inspector is for this district. It also seems, in the case of municipalities, a farce for the Provincial government to give power to establish lighting systems, and then for the Dominion government to say we will charge them a certain sum for availing themselves of the legislation enacted by the provincial authorities."—J. N. Christie, Town Clerk, Mitchell, Ont.

"We paid our license of \$25.00 and have had no inspection up to the present time. The only thing we know about it is, we are \$25.00 out."—Stratford Gas & Electric Co.

"There should be no interference. If any one wants government or any other inspection let him get it and pay for it. Why should the government compel me to pay a registration fee for selling electricity for lighting purposes and allow others to sell coal oil and other illuminants without paying a fee? The govern-

ment gives no value in return for the registration fee, and money taken without value given is simply robbery."—A. Groves, Fergus, Ont.

"We have paid \$25.00 and not received a single cent's result. It is simply robbery of small plants of villages or towns. We do not sell by meter, and there is really nothing for a government inspector to do. There is further no advantage to buyer that we can see, because if they cannot afford electric light they need not take it."—W. Moore & Sons, Meaford, Ont.

"Do not think it necessary in small places, even where there is no competition but oil, as prices are so low there is not a living profit to be made. The yearly government fees are altogether too high for small plants."—Stanstead, Que., E. L. Co.

"We only run the arc system of lighting and therefore consider inspection a perfect farce. You can only get so many amperes out of a certain wound machine, which during inspection, can be run to full amperage but with a self adjusting lamp running and producing a clear light on any current from 4 to 12 amperes, it can easily be seen that government inspection won't amount to

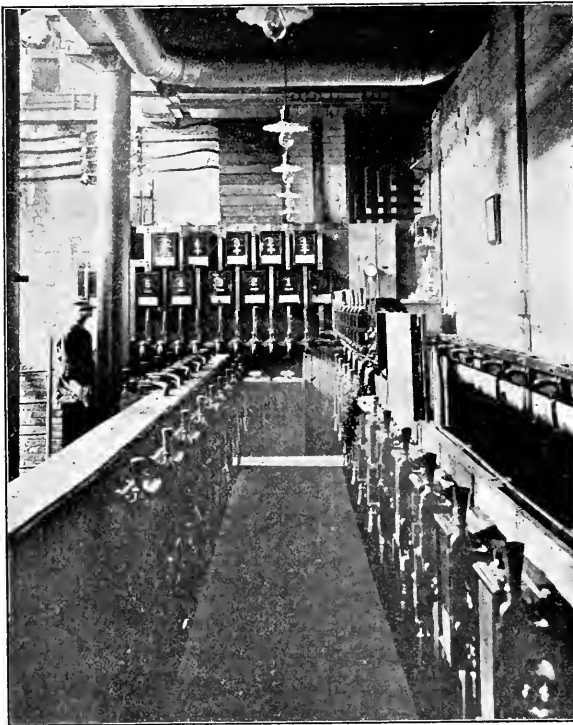
anything or be any safeguard. Competition will do it, and nothing else. The fact is the move is calculated to close out small plants, and set back our villages into the old Egyptian darkness."—Owen Sound Electric Illuminating & Mfg Co.

"(a) No, it only takes money from him and gives nothing in return. (b) Not that we have been able to find out. We think it a humbug; the party that inspected our plant did not know an alternator from an engine, but sat in our office and wrote just what we told him about our plant, and charged us \$10 for it."—Thamesville E. L. Co.

"(a) Only in case of controversy. (b) Yes. Do not know what inspection fee is for. Have not been operating long enough to say whether inspection is productive of better understanding between seller and buyer."—Peterborough E. L. Co.

"(a) It is of no advantage to the seller or

buyer in our case as we use no meters. The government taxes us \$25.00 annually, which we consider most unfair as we get no return therefor whatever. The buyers are perfectly satisfied and many of them do not know that such a thing exists. We consider that in towns of this size where the light has of necessity to be sold cheap, that there is no reason whatever for government interference, and we can see no valid reason why we should be compelled to pay a revenue tax of \$25.00 annually, when we get no return whatever for the money paid out. If we were in the tobacco or liquor trade, doing a business which some people might consider was derogatory to the welfare of the country and upon which the profits were large, we would not mind the tax. We cannot understand why the manufacturers of electric light should be compelled to pay a government tax to the revenue department any more than the manufacturers of furniture or agricultural implements. If the consumers were dissatisfied with the light given or with their meters, why could not an inspector be appointed to rectify and measure the same, and be paid by the company or the purchaser for his work without compelling us to pay out \$25 annually, same as an hotel-keeper or a man wanting a fishing license. We would



SWITCHBOARD, INCANDESCENT STATION, TORONTO ELECTRIC LIGHT CO.

favor the removal of the tax which we consider unnecessary and wrong."—Citizens' Electric Light Co., Smiths Falls, Ont.

"(a) We do not think so. (b) We do not think it would be. If the consumer be dissatisfied, he could discontinue at any time. We consider the government has no more right to interfere in this than with the buyer and seller of any other commodity. If parties don't want the light they need not buy it. We think the inspector would only tend to make or cause trouble. For instance, if the inspector arrived here during high water, we could at such time

from the act. We were simply taxed \$20 for our plants and that is all we ever heard about it. Therefore we consider this inspection fee as only a piece of imposition."—Lakefield E. L. Co.

"(a) Yes, it saves us a great amount of trouble with our customers. (b) Yes, because he can find out whether his meter is correct. The fee is not a fair one. Five dollars is enough. Decidedly the inspection has been productive of a better understanding between seller and buyer—it has settled all disputes, and we think the buyers are more satisfied with their bills. About 10 per cent. of meters run slow; we seldom find one running fast. We are decidedly in favor of some government supervision over all lighting companies—gas as well as electric—but we consider the present scale of fees charged for inspecting electric meters is too high, and in the interest of the consumer as well as the companies should be reduced at least 50 per cent." The London Electric Co.

"(a) So far as towns and villages are concerned, as they get no returns from it whatever, inasmuch as their meters are never inspected, consequently it cannot be of any benefit, unless it might be where a dispute arises between the buyer and seller, when the inspector might be called in to decide the merits of the case. (b) No. Why should a small village like Eganville, for example, where there are two electric light companies, be compelled to pay \$50 to the government as a direct tax and get no returns from it, whereas the city of Ottawa, with one large remunerative plant only pays \$25 into the public treasury and yet have the advantage of having their meters inspected regularly. There is no better understanding between buyer and seller because there is really no inspection, and the consumers do not so much as know that there is an inspector. We never had a meter sealed—the only sealing we ever had was the sealing of our \$25. My opinion is that a competent inspector should be appointed to whom all matters in dispute between the sellers and consumers should be referred, but other than that I see very little use for one." A. A. Wright, Renfrew, Ont.

"(a) It is not. (b) No. No better understanding between seller and buyer than before. Meters do not work satisfactorily



ONTARIO PARLIAMENT BUILDINGS, TORONTO.

perhaps not give the buyers 16 c. p. We cannot see that any good would come to anyone except the inspector."—Robertson, Rowland & Co.

"(a) No. (b) No, we will have to charge higher rates. We do not use meters. The fee should be only nominal in small towns like Brampton. Charge should be larger where a large quantity is sold. Five dollars would be ample fee for our town."—J. O. Hutton, Brampton, Ont.

"We do not know anything about the working of the inspection act as yet, except that we had to pay the fee, \$25.00. We do not consider that in a town like our own that anything of the kind is necessary. We are obliged to make the rates low and keep the bills small, often cutting the amount down without saying anything about it, as our people really cannot afford to pay but a limited amount as a rule, and we govern ourselves accordingly. From our experience we would say local conditions are quite sufficient to keep business right."—Carleton Place E. L. Co.

Our only competitor here is coal oil, and in order to induce the use of electricity we are obliged to make the price very low—\$4 is the highest price we get for 16 c. p. incandescent lamps by the year. We cannot see any advantage to the buyer from government interference. We presume it was to protect him the system was adopted. In our case especially, where no inspection was made, the buyers could not have been benefitted, and even had there been an inspection and we were found to be using a less voltage or amperage than we say we do, we would then simply say, 'That is our price for whatever voltage or amperage it is. So long as the light is satisfactory you can keep it, and when it is not we will take it out.'—John Beaman, Chesley, Ont.

"(a) Cannot see that it is. (b) We have not seen the advantage. Fees too arbitrary. Many companies not paying expenses. We find meters after being sealed run slow and some do not go at all. Do not consider that the electric lighting industry has arrived at a point where it requires government inspection."—Sherbrooke Gas & Water Co.

"So far as we are concerned we have seen no beneficial effects



OSGOODE HALL, TORONTO.

without periodical inspection. Competition of other methods of lighting is ample to safeguard the interests of the consumer. Government interference is burdensome and unwarranted. Hamilton E. L. & Power Co.

"We have no inspection at Joliette. We sell our lamps so much a year, and the consumer must be satisfied with the light the corporation furnish."—A. L. Marsolais, Secretary.

"(a) It is no advantage to the seller. The customer compares his bill with the size of his gas bill and cares nothing whether his meter is inspected or not. (b) No, because the companies are

not a charitable institution, and the tax must eventually be paid by the consumer. The fee is not a fair one. There is no better understanding between seller and buyer. The customer says he does not care a hang for the meter being inspected; he says, "Give me cheap light or I will go back to gas." He is no better satisfied with his bills than before. Sometimes the meters go and sometimes they don't. This country is too much governed and so are the cities. There is altogether too much interference with the liberty of the subject and most of it is done in the interests of blood-sucking parasites of the government, both state and municipal, and not to the advantage of the already overburdened taxpayer."—Toronto Electric Light Co.

"(a) No. (b) No. The fee is not a fair one. No better understanding between buyer and seller. In this small community, where electric light must be nearly as cheap as a coal oil lamp, it is difficult to get a fair price to make a plant pay expenses."—Strathroy E. L. Co.

"(a) No. (b) No. Inspection fee not a fair one. No better understanding between seller and buyer. We have no meters in use. The government should not interfere. I consider the Inspection Act of no use to any person, and it should to my mind be abolished at once."—J. B. Kelly, Blyth, Ont.

"(a) No, as his lights will cost more, therefore he will not be as well able to increase his business. (b) No, because he will have to pay more for his lights. Fee too high in my case, as no inspection has been made. I do not think there is much use for a government inspector—it is only creating a government office which takes a lot of money from owners of electric light plants without any value being given in return. I think with gas and coal oil at present prices, the interests of the consumer are perfectly safe."—D. McIntyre, Paisley, Ont.

"(a) No, it is a disadvantage to the amount of the tax collected. (b) No, as we have to charge more to make up for the tax. It is a useless expense. We do not use meters. We have to sell very low to compete with coal oil. With the various illuminants

been inspected in any way. We have no agreements with private firms, but put in lamps by the month and get a settlement each month. The lamps must all give the best of satisfaction before we can hold the job. Any one that isn't blind can tell whether a lamp is giving enough light by simply looking at it. In my case it has not made one iota of difference, and if you can find one single user of mine asking for inspection, I will give you the amount of the fee. As there was no value given I believe I could resist payment in court."—J. Warner Freure, Port Rowan, Ont.



QUEEN'S AVENUE, TORONTO.

"(a) It is certainly no advantage to the seller. (b) It is no good to the consumer. The inspection fee is not a fair one. The consumers are no better satisfied than before. We find the meters slow, and if anything goes wrong with meter there is no way of correcting it, and the station may be out of its just revenue for a long time. We think the lighting rates in Ontario at least very reasonable, and fully 50 per cent. lower than for the same service on the American side. What industry have we to-day that is a poorer investment than electric lighting? We consider the lighting rates low enough without competition, but this same competition will always be the means of keeping the price low enough."—Water, Light & Power Co., Burk's Falls, Ont.

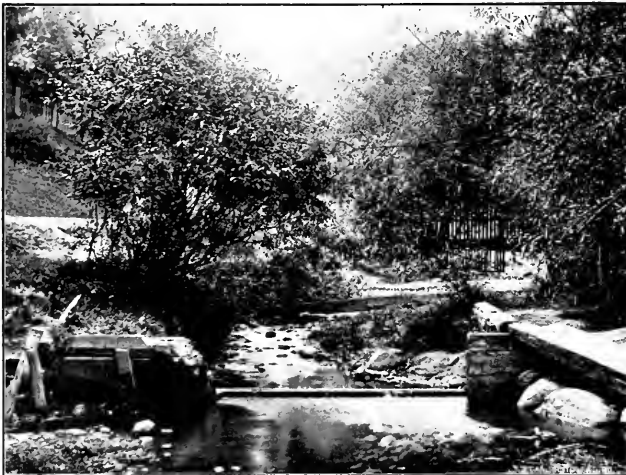
"We do not use meters on our lines and therefore do not figure in the inspection question. We recognize the right of the consumer to be protected from inferior light, both electric and gas, and the consequent duty of the government to furnish such protection. Where there is sufficient competition we believe the necessity for such interference would be greatly reduced—almost to the vanishing point."—Stormont Electric Light and Power Co.

"I know but little of the workings of the Act. The only experience we have had with it is to pay the annual fee or tax. Our meters have not been tested by the Government Inspector, though we got notice that he was to have been up this way last December."—J. W. Schell, Electrician, A. Walker & Sons, Ltd., Walkerville, Ont.

"Government inspection stops all disputes as to correctness of meters, and prevents friction between company and consumer. No inspector has yet been appointed in this district."—Manitoba Electric and Gas Light Co., Winnipeg.

"Our general opinion is that the government should not interfere at all."—Stayner E. L. Co.

"We think the act is all right in cities of 25,000 or more inhabitants. It seems a hardship and a useless one in small communities. Considering that gas inspectors do the work without extra pay, and that meters are brought to them and taken away and current furnished to them free of charge, the fees are too high."—Ottawa Electric Co.



SCENE IN RESERVOIR PARK, TORONTO.

for shop lighting, no man is compelled to use electric light, therefore the seller must make electric lighting an object to the buyer, both in cheapness and efficiency of light."—Hamilton & Prouitt, Forest, Ont.

"In my case it was simply highway robbery. No advantage to either seller or consumer. Inspection fee not a fair one. Consumers no better satisfied. No experience with meters. This is a case of sticking a nose in where it was not asked for. Last year I paid a fee under threat of a heavy fine. At the same time I had not a single meter in public use, and the plant has never

1st HOUR.

2nd HOUR.

3rd HOUR.

4th HOUR.

5th HOUR.

6th HOUR.

7th HOUR.

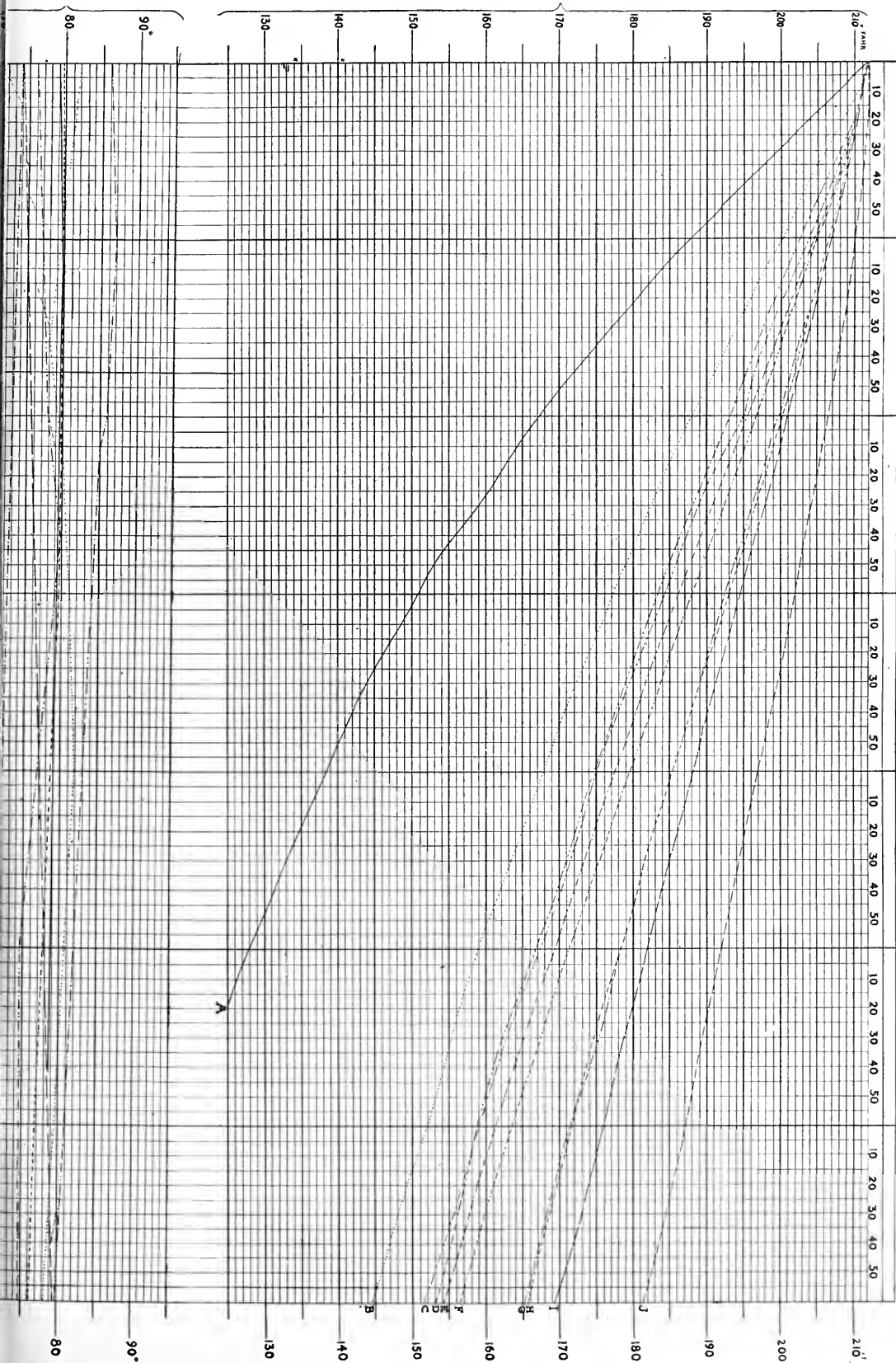
W. C. Brown
Master



DIAGRAM OF EXPERIMENTS WITH BOILER COVERINGS.

Reproduced from Canadian Pacific Railway Company's Chart.

[For particulars see next page.]



THE ELECTRIC LIGHT INSPECTION ACT.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—Referring to your article in the May publication in respect of complaints as to the administration of the Inspection Act, permit me to offer a few observations in reply thereto.

You state that "there seem to exist doubts in the minds of some regarding the necessity for such a system." I can very well believe such to be the case. I remember distinctly when the Weights and Measures Act was first put into operation there was manifested very decided opposition to it by the traders throughout the country, who could see no necessity for the interference by Government with their concerns. And in like manner the gas companies saw no necessity for the law when extended to cover the sale of their product. But where will we find the trader of any respectability to-day, or the gas company that will not say that the legislation in question has been wise and beneficial to their interests?

We have on exhibition in the Department here some specimens of what traders in early days considered proper contrivances as weighing machines. Let me give you one illustration out of a large number. It is intended for a set of scales. The beam consists of an old whiffle-tree, such as may be found lying around in almost any farm yard. The centre or back hook was used for the suspension and the pans were hung from the hooks at either end. The pans are made of two pieces of one inch pine board about one foot square, and are suspended from the whiffle-tree by pieces of rope of varying sizes. The owner of this contrivance doubtless considered the confiscation of it by the Department as a most unwarrantable act—in fact had very serious doubts as to the necessity for the system.

In like manner with the gas. The law required that illuminating gas should be of a certain standard of purity and that a Bunsen burner consuming five cubic feet per hour should produce a light equal to 16 standard candles, and that the measure or apparatus through which it was sold should be accurate. At first it was found most difficult to get the companies to satisfy the requirements of this standard—about 12 c.p. being the best they could then produce. Gradually, however, they did satisfy the demand and now find no difficulty in giving 18 to 20 c.p. to the five cubic feet. It is not claimed, of course, that the Inspection Act is entitled to all the credit for these improved conditions, but we do contend that it was a very important factor in bringing them about.

As with the question of gas and gas meters, so it is with respect to electricity and electric meters. The ordinary weights and measures standards could not be used to verify the apparatus through and by which electricity is sold, consequently it was found necessary to legalize a system of standards and verification suited to the new conditions that existed with respect to this commodity. It is, as has often been explained before, simply an extension of the weights and measures system to cover the sale of electricity. This system has been in operation for twenty-five years, and the Government and Parliament of Canada has not up to the present time received a single petition from any section of the people of the country asking that it be abolished.

As to the methods that have been adopted for the inspection of electric meters and pressure, this is, of course, a legitimate subject for discussion between the electric lighting industry and the Government. It was thought at the outset that the gas inspection service could be used advantageously in carrying out this new work. The Department is still of this opinion. The first year's work has been mainly that of organization.

The inspectors have been confined almost exclusively to the verification of meters at headquarters, thus enabling them to become acquainted with the use of their instruments and the handling of the electric current. During the ensuing year it is intended that each inspector shall visit each electric lighting station at least twice, and oftener if needed, to verify meters, compare voltmeters and test the pressure under full load.

In respect of the registration fees, about which a good deal of complaint has been heard, the writer is free to admit that for the smaller companies it is somewhat high. Acting under this impression in September last the Department made a rebate of fifteen dollars to all companies having installations of 500 lamps and under. Since that time the Department has been considering whether in future this reduction can be extended to all companies having installations of 5,000 lamps and under. This would include all, with the exception of about a dozen of the larger companies.

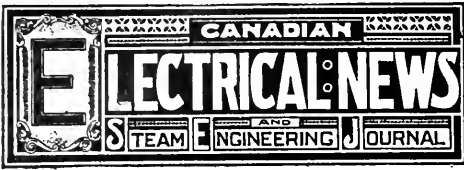
In connection with the testing of meters it is claimed that meters, after having been sealed by the Government Inspector, have stopped altogether, "owing to the formation of a substance on the commutator." Is it contended that this formation is due to the fact that the meter has been sealed by the inspector and not by the company? Is it claimed that the seller should have access to the meter and that the buyer should be debarred from such access? Clearly, if there is any sealing to be done at all it is the inspector who tests the meter and who is the disinterested party who should do it. There are, no doubt, isolated cases where the direct-current mechanical meter has "slowed up" under heavy load, but to contend that this is a frequent occurrence, and that it needs cleaning every few weeks, is a libel on the meter. If, however, there are difficulties of this kind with respect to this particular meter, let the manufacturers submit their case to the Department, and I venture the assurance that the difficulty will be met if at all possible.

Your May article also charges our inspectors with "posing as electrical engineers." This matter has been carefully investigated and no foundation whatever in fact can be found for the charge. The inspector at Hamilton, it is true, when appealed to by a personal friend on the directorate of the Hamilton Electric Light Co. for his opinion as to the cause of the enormous consumption of fuel under the boilers of the steam plant there, suggested that possibly the chimney was too small, and offered the mechanical engineer of the company the use of certain works or authorities upon the subject. Beyond this he did not go. If this can be called "posing as an electrical engineer" I fear we shall have to plead guilty.

Now a word in conclusion as to the opinions which have been solicited from the companies in reply to a number of leading questions submitted to them; copies of which you have been good enough to send me. Opinions of this sort can always, of course, be very readily obtained, and the Department might meet them three to one with appeals from corporations and individuals all over the Dominion, asking for tests and investigations of various descriptions in connection with electric lighting. The statement that there is no dissatisfaction—no friction—between the contractor and the consumer, is one notoriously at variance with the facts. From personal observation the writer is perfectly well aware of this friction, and is also aware that not a few of the companies have experienced much satisfaction from our work.

Whilst testing meters in a small town some time ago we offered to compare the station voltmeter with the Departmental standard, and on doing so it was found that the pressure had been maintained four volts in excess of what the lamps called for. The company had been blaming the lamp dealers with supplying poor lamps, but the trouble was found to be in the inaccuracy of the voltmeter. The manager was well pleased with the test and expressed himself as being quite sure the saving in lamps would pay the registration fee of \$10 many times over.

O. HIGMAN,



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. F. Lane, President; T. Pilgrim, Vice-President; Joseph Ogle, Secretary, Brantford Cottage Co.

LONDON BRANCH NO. 5.—Meets once a month in the Huron and Erie Loan Savings Co.'s block. Robert Simmie, President; F. Kidner, Vice-President; Wm. Meaden, Secretary Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p.m. J. Fordyce, President; J. Tuck, Vice-President; H. T. Flewelling, Rec.-Secretary; J. Gerry, Fin.-Secretary; Treasurer, C. J. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Horbridge's hall, Kildare street; Frank Robert, President; F. Merrill, Secretary, 352 Wellington street.

PRESIDENT BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. J. R. Uley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King street, at 8 p.m. President, S. Donnelly; Vice-President, Henry Hopkins; Secretary, J. W. Tandvin.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block, Charlotte street. President, Daniel Bennett; Vice-President, Percy C. Walker, Waterworks; Secretary, J. W. Tandvin.

WIARTON BRANCH NO. 13.—President, Wm. Cradock; Rec.-Secretary, Ed. Dunham.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. S. Potter, President; C. Robison, Vice-President; W. Sharp, engineer steam laundry, Charlotte street, Secretary.

BROCKVILLE BRANCH NO. 15.—President, W. F. Chapman; Vice-President, A. Franklin; Recording Secretary, Wm. Robinson.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, A. AMES,	Brantford, Ont.
Vice-President, F. G. MITCHELL	London, Ont.
Registrar, A. E. EDKINS	139, Jordan St., Toronto.
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TORONTO—A. E. Edkins, A. M. Wickens, E. J. Phillips, F. Donaldson.

HAMILTON—P. Stott, R. Mackie, T. Elliott.

BRANTFORD—A. Ames, care Patterson & Sons.

OTTAWA—Thomas Wesley.

KINGSTON—J. Devlin, (Chief Engineer Penitentiary), J. Campbell.

LONDON—F. Mitchell.

NIAGARA FALLS—W. Phillips.

Information regarding examinations will be furnished on application to any member of the Board.

Possibilities of Alternating Currents for Railway Purposes.

In our columns, recently, we have given the ideas of several individuals as to the possibilities of alternating currents for railway purposes. It seems to have been generally conceded that, while there was no reason on theoretical grounds why they should not be used, still for practical reasons, conditions of service would require to be favorable before they could become suitable. It is interesting to observe, however, that quite recently an electric railway working on the three-phase system has been started in the north of Italy, at Lugano. The details of the construction are in many respects so different from those standardized this side of the Atlantic, as to make their study interesting and instructive. The application of the polyphase system itself to railway work, is so far as we are aware, quite the first instance of the kind except for experimental purposes. Power is taken from a water-fall seven and a half miles from Lugano. This fall already supplies power for the electric lighting of the town by the alternating system, and for other electrical purposes. The three-phase generator is of 150 h.p. The voltage is 5,000, generated direct without the assistance of step up transformers. This is in itself a feature of importance, as thereby the inevitable losses in transformation are avoided, and is rendered possible by the design of the generator, which is of the stationary armature revolving field type. The frequency of the alternations is 40, considerably less than the number usually adopted in this country. As all induction, capacity, and hysteresis losses increase directly with the frequency of alternations, the reduction of the frequency is a matter of engineering importance. It is true that below about 60 cycles per second the flickering of lights affects the eye, but as the real field for polyphase alternating currents is for power transmission and utilization, this consideration loses considerably in importance. On

the railway line the currents are conducted by means of two over-head wires, and the rails, which are bonded together in the usual manner. Another departure from our usual practice is in the matter of the power of the motors. The cars have a seating capacity of twenty-four; the grades on the line run as high as six per cent.; the speed averages nine miles per hour; and yet each car is equipped with only one twenty-five horse power motor. In many ways, therefore, the line is worthy of being carefully studied, and might serve as an object lesson to those whose engineering ideas have a tendency to fall into grooves.

THE absence of really proper and competent consideration of the general features and preliminary engineering of electric plants has been prominently brought forward in two recent cases. A town of 6,000 inhabitants, long and narrow, with scattered houses, was supplied with lights on the direct current system; and a small place of nearly 1,000, concentrated round the railway station, was wired upon the alternating plan. In the former case, a house distant almost 15,000 feet from the power house had to be supplied, and was reached by the ingenious though complex method of transmitting at 220 volts by using the outside wires of the three-wire system, and then reducing down to the lamp voltage of 104 by availing of the additional drop caused by a water resistance. The copper required for feeders, mains, etc., was a very large amount, and the plant did not pay. In the latter case, the voltage being high and the distance small, it was impossible, without using wires too small to put on poles, to keep the voltage at the lamps down enough, and they kept on burning out. And besides this, the resultant cost of generator, transformers, etc., was considerably higher than the price of a direct current installation would have been. Electrical investors should remember that the selection between alternating current and direct current machinery is not a matter which should be decided purely on grounds of personal preference, but it should rest on well considered engineering and commercial considerations. The alternating current system was evolved out of the inadequacy of the direct current system to properly meet certain conditions, but the fact that its use is most advantageous in those circumstances, is no reason for thinking it to be the best under all. Other things being equal, the direct current has the best of it on the score of efficiency, and as for lighting or power, the one possesses no advantage over the other (granting the use of alternating current motors, and disregarding the possibility of using storage batteries). Their comparative merits seem therefore to reduce to a question of comparing the costs of the two systems. Referring everything to the standard of two-wire direct current working, we find that to transmit the same total power, at the same total loss, over the same distance, the direct current two-wire takes 100 per cent. of copper; the direct current three-wire takes 37½ per cent.; the alternating system at 1,000 volts takes about one per cent. So the alternating system has the advantage over the three-wire direct by 36 per cent. But in order to do this we have to use transformers, which may quite counterbalance this advantage, unless the distances be great. And this does not take into consideration the extra losses due to the transformers. In a 1,000 light installation, the cost of the transformers will be certainly not less than \$800, so

that unless the total diminution of first cost of wire by the use of the higher voltage be greater than \$800, the direct current is actually the cheaper system to use. Even if the saving in wire amounts to \$800, the direct current will be the more economical system, because the transformers themselves have many inherent losses due to hysteresis, leakage, and heating; and these will necessitate an expenditure for fuel that will be obviated by the direct current. The above considerations show that every lighting or power enterprise should be very carefully considered before deciding on the class of machinery to use.

It would be interesting to learn what Lightning Arresters. effect the recent violent thunderstorms have had in directing the attention of owners and superintendents of electric light and power stations to the necessity of adopting devices for the protection of their machinery from lightning. It may possibly be but a coincidence that several enquiries regarding lightning arresters were received at this office immediately following the recent storms. The electric stations appear to have come through these storms with very little loss, but this is not likely to happen on every occasion, and protective devices should be regarded as one of the most important features of the equipment of every electric station.

WE may shortly look for a final decision regarding the proper interpretation of that section of the Canadian tariff relating to the duty on steel rails. The Privy Council will shortly adjudicate upon the question in response to an appeal taken by the Toronto Railway Co. from the decisions of the inferior courts, under which it was held that steel rails of the weight now mostly used in electric railway construction are subject to duty. The Toronto Railway Co. are seeking to recover a sum exceeding \$50,000 paid as customs duties several years ago, in accordance with this interpretation of the tariff. The decision of the Privy Council will be awaited with much interest by electric railway companies throughout Canada, and by the projectors of new roads, whose interests are affected.

THE dreadful occurrence at Victoria, B. C., on May 26th, is we believe the first accident on an electric railway in Canada in which more than a single life has been lost, or in which injury resulted from the cars leaving the track. Since electric railways have come to occupy in many instances the same position as steam roads, greater precautions than heretofore will be required in their construction and operation. The main cause of the accident at Victoria seems to have been the want of a sufficient factor of safety in the bridge over which the cars were required to pass. Had the proper amount of surplus strength been allowed in the construction of this bridge, it probably would not have collapsed in consequence of the cars jumping the track. On the other hand, the cars seem to have left the rails because of being rendered top-heavy by the overload of passengers seated on the top and clinging to the sides of the cars. Railway bridges of all kinds should be subjected to periodical inspection, and managers of electric railways should not allow passengers to overcrowd their cars in the manner described.

Governing Features of Electric Installations.

The Electric Railway Accident at Victoria.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

At the annual meeting of this Association held at Galt on the 1st inst., representatives of the various lodges throughout the province were present, from whom encouraging reports were received.

Officers were elected as follows: A. Ames, Brantford, president; T. S. Mitchell, London, vice-president; R. Mackie, Hamilton, treasurer; A. E. Edkins, Toronto, registrar. Board of Examiners—James Devlin, Kingston; J. W. Bain, Toronto; W. Donaldson, Ottawa; Wm. Stott, Hamilton.

A resolution was passed authorizing careful enquiry by the officers of the Association into the causes of boiler explosions.

A delegation consisting of Mr. James Devlin, Kingston, Mr. A. M. Wickens, Toronto, and Mr. A. E. Edkins, London, was appointed to interview Sir Charles Tupper in behalf of Dominion legislation for the examination of engineers in all parts of the Dominion.

The next meeting will be held in Toronto on the 6th of June, 1897.

A CANADIAN MANUFACTORY OF ACETYLENE GAS.

WITHIN the past month Mr. T. L. Willson, the inventor of acetylene gas has commenced the erection of a factory at St. Catharines, Ont., in which to manufacture the gas. Judging by the size of the factory it is not proposed to conduct operations on an extensive scale. It is reported that Mr. Willson has entered into a contract to supply the St. Catharines Gas Company with a certain quantity of acetylene for enriching purposes, and that his purpose is to endeavor to effect a similar arrangement with the gas companies throughout the Dominion.

PERSONAL.

Mr. E. Carl Breithaupt, of Berlin, was recently elected a member of the American Society of Electrical Engineers.

Mr. H. P. Brown, consulting engineer, of New York, has been engaged by the Hamilton Radial Railway Company.

Mr. W. J. Camp, electrician of the C. P. R. Telegraph Co. was a recent visitor to New York, where he had a conference with the Postal Telegraph Co.

Mr. A. W. Congdon, of the General Electric Company's staff, has been confined to his home by illness for a couple of months past. His friends will be pleased, however, to learn that he is now on the way to recovery and hopes to be able to resume his duties shortly.

Mr. Charles H. Wright, son of Mr. A. A. Wright, of Renfrew, Ont., was eminently successful in his recent examinations at McGill University, Montreal. He took honors in electrical engineering, hydraulics, thermodynamics and physics, and headed the list of passmen in the electrical engineering branch.

Among the visitors from Canada to the recent convention of the National Electric Light Association in New York, were Frederic Nicholls, manager G. E. Co., Toronto; Mr. W. H. Brown, manager Royal Electric Co., Howard D. Black, Prof. Henry T. Bovey, Montreal; F. H. Badger, Jr., manager Montmorency Light & Power Co., Quebec; and Chas. B. Hunt, manager Electric Light & Power Co., London, Ont.

Mr. W. C. Cheney has been appointed general superintendent of the Consolidated Railway and Light Company, Victoria, B. C. He will exercise a general supervision of the system in Victoria, Vancouver and New Westminster, making his headquarters at Victoria and giving the tramway and lighting system his personal attention. Mr. Cheney is an electrical engineer of recognized ability, and resigned as superintendent of the Portland General Electric Co. to accept his present position. He has been connected with some of the largest electric power plants of America.

TRADE NOTES.

The Regina Electric Light & Power Co. have ordered a 500 light alternator from the Canadian General Electric Co.

The Beardmore Co., of Toronto, are putting a new 100 h. p. Goldie & McCulloch engine in one of their tanneries at Acton.

The Rogers Electric Co., of London, have been awarded the contract for an electric light plant at the London water works.

Mr. John Crowe, of Montreal, has placed an order with the Babcock & Wilcox Company, of Montreal, for one pair of their 250 h. p. improved all wrought steel high pressure water tube boilers.

The Canadian General Electric Co. are installing a very compact marine lighting set on the new steamer "Corona." The generator is a standard multipolar 250 light machine direct coupled to a vertical marine type engine constructed at the Peterboro' works of the company.

The Canadian General Electric Co. are supplying a very complete isolated plant for the Montreal General Hospital consisting of two generators of 40 kilowatts capacity each, and one of 17 kilowatts capacity. These machines will be of the company's new moderate speed multipolar type.

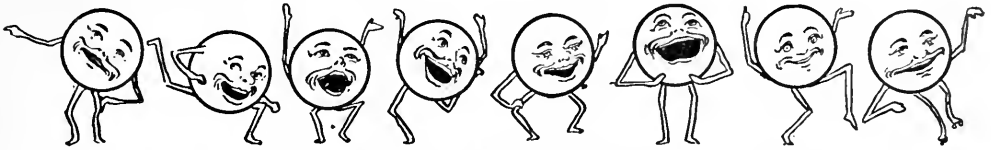
The Packard Electric Co. are issuing monthly in miniature form a little memorandum book entitled "Daily Notes" containing blanks for memoranda for each day of the month. The last four pages are devoted to the company's advertisements. The idea is a unique one, and will, no doubt assist in widening the circle of the company's acquaintance.

The Kay Electric Mfg. Co., of Hamilton, have recently supplied the following machines:—A 10 k. w. dynamo for the Gendron Mfg. Co., Toronto; an electro-plating dynamo for the Ontario Silver Plating Co.'s branch at Niagara Falls, N. Y.; a 20 k. w. lighting dynamo for the Eagle Knitting Co., Hamilton; a 30 h. p. motor for Wideman & Clemens, Guelph; a 4 h. p. motor for Gemmel's laundry, Hamilton; a 6 h. p. motor for the McLean Pub. Co., a 4 h. p. motor for Mr. Carlisle, and a 5 h. p. motor for Wm. Beers, all of Toronto.

The Montreal Street Railway Company have placed an order with the Babcock & Wilcox Company, Board of Trade Building, Montreal, for three batteries of their improved all wrought steel high pressure water tube boilers. These boilers are intended to furnish steam for the new 4,000 h. p. engine which they have ordered for their William street power house extension. Probably no more perfect installation of Lancashire or Galloway boilers has ever been made, certainly not in Canada, than the present extensive plant in the William street power house. The showing made by the Babcock & Wilcox boilers proved too attractive, however, and the management of the Montreal Street Railway have determined that their plant will be provided with just as good machinery as the great street railway plants in the United States.

Mr. Wm. T. Bonner, general Canadian agent for the Babcock & Wilcox water tube steam boilers, furnishes the following information regarding the geographical distribution of their orders as given in their last month's sales report: American sales—3,374 h. p. in New York, 560 h. p. in Pennsylvania, 400 h. p. in Florida, 160 h. p. in California, 3,350 h. p. in Massachusetts, 250 h. p. in New Jersey, 200 h. p. in Rhode Island, 6,400 h. p. in Illinois, and 6,880 h. p. in Maryland. The foreign sales were divided as follows: 1,322 h. p. in Russia, 74 h. p. in Norway, 1,353 h. p. in France, 3,453 h. p. in England, 140 h. p. in Belgium, 294 h. p. in Spain, 76 h. p. in Portugal, 126 h. p. in Scotland, 192 h. p. in Germany, 72 h. p. in Holland, 424 h. p. in South Africa, 332 h. p. in Sweden, 52 h. p. in Italy, 280 h. p. in Brazil, and 228 h. p. in Madagascar. The foreign list foots up to 8,418 h. p., while the American list amounts to 21,583 h. p., or a total of 30,001 h. p. for the month, of which 7,000 h. p. are marine boilers. The above report indicates only an average month's business. The total number of Babcock & Wilcox boilers now in use aggregates nearly 2,000,000 horse power.

The Lachine Rapids Hydraulic and Land Company have selected the three-phase system of the Canadian General Electric Co. for their new transmission plant. The initial order for the generators covers 12 machines, each of 1,000 horse-power capacity. This will, with one exception, be the largest power transmission plant in the world. A full description of the details of this most interesting installation will be given to our readers in an early issue.



"RADIANT MATTER" as reflected in the countenances of members of the Canadian Electrical Association who contemplate attending the Toronto Convention.

CANADIAN ELECTRICAL ASSOCIATION.

PARTICULARS OF THE APPROACHING ANNUAL CONVENTION.



In the May number of the **ELECTRICAL NEWS** reference was made to the Sixth Annual Convention of the Canadian Electrical Association which is to take place in Toronto on the 17th, 18th and 19th inst. The arrangements for this convention are now practically complete, and we are enabled to publish herewith the exact program, as follows:

HEADQUARTERS—COUNCIL CHAMBER, BOARD OF TRADE.

BUSINESS PROGRAM.

JUNE 17TH.

- 2:30 P. M. Opening of first session in Council Chamber, Board of Trade Building, Yonge and Front Streets.
 President's Address.
 Reading Minutes of last Meeting.
 Secretary-Treasurer's Report.
 Reports of Committees.
 General Business.
 Presentation of Papers.
 Discussion.

JUNE 18TH.

- 10:00 A. M. Consideration of Reports of Committees.
 Election of Standing Committees.
 Selection of Place and Time of next Meeting.
 Election of Officers and Executive Committee.
 General Business.
 Presentation of Papers.
 Discussion.

JUNE 19TH.

- 10:00 A. M. Presentation of Papers.
 Discussion.
 General Business.

LIST OF PAPERS.

- "Ocean Cables," (Historical), Chas. P. Dwight, Toronto.
 "Acetylene Gas," (with demonstrations), Geo. Black, Hamilton.
 "Meters," James Milne, Toronto.
 Consideration and Discussion of the Government Electric Light Inspection Act.
 "Some Central Station Economics," P. G. Gossler, Montreal.
 "Power Transmission by Polphase E.M.F.s," Geo. White Fraser, Toronto.
 "Operating Engines without a Natural Supply of Condensing Water," E. J. Phillip, Toronto.
 "The Outlook for the Electric Railway," F. C. Armstrong, Toronto.
 Several of these papers will be illustrated by electric projection of diagrams, and the interest thereby greatly enhanced.

SOCIAL FEATURES.

JUNE 17TH.

- 8:00 P. M. Members and ladies will attend an illustrated lecture by Mr. James Milne entitled "Radiant Matter," to be delivered in the Rotunda of the Board of Trade, showing Prof. Cook's experiments and also demonstrations of Roentgen rays. Interesting shadowgraphs will be taken and exhibited.

JUNE 18TH.

- 5:00 P. M. Excursion per Steamer "Greyhound" to Lorne Park. Annual Banquet to members and ladies at Hotel Louise, followed by moonlight sail on Lake Ontario, returning to Toronto about 11 P. M.

JUNE 19TH.

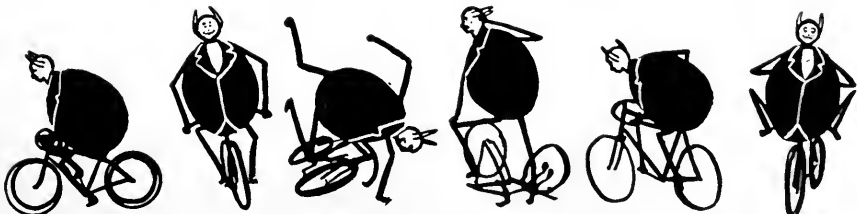
- Arrangements are being made for an excursion by boat around Toronto Island, along the water front to Scarborough Heights, and return.

NOTE.—During the progress of the convention opportunity will be afforded for inspection of the power stations of the Toronto Electric Light Co. and the Toronto Railway Company.

The subjects of the papers to be presented at this convention appear to have been wisely selected. Most of the questions treated of are destined to have an important bearing upon the electrical interests, and their full consideration and discussion at the present juncture is most desirable. We have every confidence in the ability of the gentlemen who have undertaken to prepare these papers to make them both interesting and instructive. We are quite in accord, however, with the view expressed by some distinguished gentleman whose name we cannot recall, that the chief value of papers of this character lies in the discussion arising out of them. If, therefore, the full benefit is to be got from this interesting series of papers, members of the Association must familiarize themselves with the views expressed by reading and carefully digesting the advance copies which are usually available some days previous to the meeting, and come to the convention prepared to express their opinions and do their share towards promoting a full and profitable discussion.

Take for example Mr. Gossler's paper on "Some Central Station Economics." What more interesting or important subject than this to every owner and manager of a central station? If central station men will make a point of attending the convention, take a hand in the discussion of this paper, and compare notes with each other, a fund of information regarding central station management of the greatest benefit to every central station manager will be the outcome. It is due likewise to the author of a paper on which much effort has been expended, that his audience should express themselves regarding the correctness or otherwise of the views he enunciates.

There has been manifest at past conventions of the Association hesitation on the part of the majority of the members to express their views. We hope to see this spirit disappear at future meetings. The members will better advance their own interests and the welfare and usefulness of the Association by hazarding their opinions,



Barring "Bug"—bears such as bad roads, punctures, etc., this contingent of members of the Canadian Electrical Association expect to arrive in Toronto at sunrise on the 17th inst.

whether correct or otherwise, than by refraining from taking part in the proceedings.

Opportunity is to be given for a discussion upon the merits of the Electric Light Inspection Act. Judging from the correspondence published in this number, this is a subject in which central station men feel a keen interest, and upon which large numbers of them feel competent to express their opinions. We accordingly look for a good representation of the electric lighting interests, and a lively discussion on the inspection system.

Regarding the social features of the program, they appear to be of a somewhat different character from those of previous occasions, and are commendable on account of their variety in this respect. There is little doubt that they will prove as enjoyable as could be desired. Toronto is at all times an attractive and interesting city, and at no time does she appear to better advantage than in "leafy June." In support of this statement we present in this issue a number of views of her public buildings, parks, etc.

It is hoped and expected that members of the Association, a large proportion of whom reside within one hundred miles of Toronto, will seek relaxation from the arduous duties of the political campaign by coming to Toronto on the 17th inst. and assisting in making this the best convention ever held under the auspices of the Association.

The feed water for a steam boiler should not be introduced in such a way as to allow it to strike

against the shell, but should be discharged into the body of water already there.

When a watch becomes magnetized by intimacy with a dynamo, the mainspring, being tempered, becomes a magnet, and, as it unwinds, its attraction, varying in direction or intensity, causes the rate of escapement to vary at different hours of the day.

A writer to a contemporary suggests a means of repairing the insulation of commutators. He says he has found that litharge mixed to the consistency of thick cream with glycerine and applied to the cracks of the commutator, restores the insulation. After being applied it should be allowed to dry 10 or 12 hours and then filed down level with the top of the commutator segments.

SPARKS.

A new metallic telephone line will be built between London and Sarnia.

The Woodstock, N. B., Electric Light Company have recently added two large dynamos.

The Hull Electric Company have purchased thirty acres of land at Aylmer as a site for a park.

Debentures are being offered by the village of Kaslo, B. C., to raise funds for an electric light plant.

The ratepayers of Iroquois, Ont., have voted down a proposition to light the streets by electricity.

The Hull Electric Company are erecting poles and stringing wires for the electric lighting of Hull, Que.

Cunningham & Hinton, electricians and electrical goods, Victoria, B. C., have dissolved partnership. G. C. Hinton continues.

Mr. R. Anderson, of Ottawa, is installing an electric light plant for Mr. Geo. Brigham on his passenger boat which runs between Ottawa and Hull.

The City Council of St. Catharines, Ont., has invited tenders for electric street lighting for a period of five years from 31st October next.

A company seeking incorporation is the Callendar Telephone Exchange Co., of Brantford, Ont., to manufacture telephones and electrical apparatus.

The suit of the town of Three Rivers, Que., against the Royal Electric Company, Montreal, has been dismissed with costs. The case involved an amount of \$13,000.

Dr. W. W. Jacques, of Boston, an electrician, connected with the Bell Telephone Company, announces the discovery of a method of taking electrical energy direct from coal.

On May 12th the town of Perth, Ont., granted a bonus of \$5,000 for an electric railway between that town and Lanark, the road to be running by September 1st. The distance is twelve miles.

The Victoria Telephone Co. is applying for

incorporation, with a capital stock of \$25,000, to operate in Victoria county, N. B. Among the promoters are J. E. Porter, Andover; Albert Brymer, Perth Centre; and Stephen Scott, Bairdville.

The rights of the Standard Light & Power Co. to lay wires underground in the streets of Montreal have been transferred to the Citizens' Light & Power Company, which is controlled by the Lachine Rapids & Hydraulic Company.

New Westminster and Vancouver, B. C., are now connected with Chilliwack by telephone, through the enterprise of the New Westminster and Burrard Inlet Telephone Co. The distance is seventy miles. The line used for the connection is the old telegraph wire, which the company have taken over. The manager, Mr. H. W. Kent, states that tariff sheets are now being prepared, and tolls for conversation will be very reasonable. Message rates will be the same as formerly by telegraph. The new line will be equipped with the best and most improved long distance instruments.



TORONTO BOARD OF TRADE BUILDING,
Headquarters of the C. E. A. Convention, June 17, 18, 19, 1896.

THE N. E. L. A. CONVENTION.

THE recent convention and exhibition in New York City under the auspices of the National Electric Light Association of the United States, appear to have been attended by more than ordinary success. The proceedings of the convention were about on a par with those of previous meetings of the Association. On the other hand the exhibition surpassed anything of the kind previously attempted, excepting only the electrical display at the World's Fair. Side by side with the electrical apparatus of to-day were to be seen the rude devices employed when electricity was in reality "in its infancy." The extent of the public interest awakened by this exhibition, may be judged by the fact that on some days the attendance reached the high figure of 50,000.

As foreshadowed in the *ELECTRICAL NEWS* for May, Mr. Frederic Nicholls, manager of the Canadian General Electric Co., Toronto, secured election as President of the Association for the ensuing year, an honor of which that gentleman and Canadians generally have cause to feel proud. Mr. Nicholls, whose portrait is herewith presented, is too well known on this side of the line to require any extended reference in these pages. He had his birth place in England forty years ago, and in that country and Germany received an efficient education. Upwards of fifteen years ago he became a resident of Toronto, where step by step he has risen to the position of prominence he now occupies in the business world.

Mr. Nicholls may be classed among the pioneers in the electrical business in Canada, having organized the Incandescent Light Co., of Toronto, and held the management thereof until a few months ago. He is also a director of the Toronto Electric Light Company; president of the Brantford Street Railway Company; vice-president of the Peterborough Street Railway Company; secretary of the London Electric Light Company, a director of the Toronto and Scarboro Railway Company, and in addition is interested in mining, insurance, publishing, and other enterprises.



MR. FREDERIC NICHOLLS,
President of the National Electric Light Association.

TECHNICAL SCHOOL EXAMINATIONS.

THE examinations in "Electricity" and "Steam and the Steam Engine," at the Toronto Technical School were quite successful, a number of the students obtaining a high percentage of marks. The following are the names of the successful ones, in order of merit:

Electricity—R. C. Harris, Herbert S. Small, equal; Walter Inglehart, Walter Redpath, Alex. Rose, H. Amos, H. F. Hutchison, Thos. P. Marshall, E. Harris,

H. C. Champ, Fred. J. Grant, Wm. Simpson, Wm. Willis, W. Piercy, Alex. Gerry, Sam. J. Evanson.

Steam and the Steam Engine—R. H. Johnston, Walter Inglehart, W. Piercy, Walter Redpath, H. C. Champ, H. Amos, Wm. Simpson, Alex. Gerry, Fred. J. Grant, J. Mitchell.

PRESERVING TELEGRAPH POLES.

IN the preparation of posts for the telegraph service in Sweden, the following simple, effective and cheap method of preserving wood from decay is said to be employed: A square tank, having a capacity of some 200 gallons, is supported at a height of 20 feet or 25 feet above the ground by means of a light skeleton tower built of wood. A pipe drops from the bottom of the tank to within 30 inches of the ground, where it is connected with a cluster of flexible branches, each ending

with a cap having an orifice in the centre. Each cap is clamped on to the larger end of a pole in such a manner that no liquid can escape from the pipe except by passing into the wood. The poles are arranged parallel with one another, sloping downward, and troughs run under both ends to catch drippings. When all is ready, a solution of sulphate of copper, which has been prepared in the tank, is allowed to descend the pipe. The pressure produced by the fall is sufficient to drive the solution, gradually of course, right through the poles from end to end. When the operation is ended, and the posts dried, the whole of the fibre of the wood remains premeated with the preserving chemical.

Prof. Palaz gives the following figures as to the relative heating effects of different illuminants: Arc light, 4; incandescent light, 14; kerosene, argand burner, 331; gas, argand burner, 380; candle, 473; gas, butterfly burner, 511.

SOME EXCEPTIONS TO OHM'S LAW.—It has been observed, says the London Electrical Review, that amongst the liquids there are certain of low conductivity; for example, benzene, xylene, and turpentine, which do not seem to follow Ohm's law, but which, under the continued influence of a high electromotive force, show a gradual alteration in conductivity. These liquids also exhibit the phenomenon of electrical convection, a current of the electrolyte setting in from the one electrode, whilst the other appears simply to attract the repelled liquid. Recently, Emil Warburg has been investigating these phenomena. He employed mixtures of liquids which possessed low conductivity, gradually reducing the proportion of one of the constituents until the conductivity was nearly that of the other. Such mixed solutions as these were found still to exhibit the above phenomena. The behaviour of these solutions, in fact, was such that Warburg is led to the conclusion (vide Ann. Phys. Chem., 1895 [2], liv., pp. 306-433), that they contain an electrolyte in a state of great dilution, upon which their conductivity depends. He suggests that the extraordinary behaviour of the so-called pure liquids is capable of a similar explanation.

CORRESPONDENCE

A WARNING TO INVENTORS AND PATENTEES.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR, In a recent issue of the Scientific American, a matter was brought before its readers, which, from its importance, deserves to have all the publicity which can be given it, and from that paper are taken the quotations in this letter. There exists in the United States, and in Canada too, unfortunately, a class of men who have adopted the opinion that the inventor is made to be victimized and "who try their best to exploit the community of patentees for their own benefit and the consequent detriment of their clients."

"When letters patent are awarded, the drawings and claims of the patent and the inventor's name are published in the Official Gazette of the United States patent office. This appeals at once to a large number of sharks, calling themselves "patent agents" who see in the inventor a possible source of revenue. As soon as the patent is issued the inventor therefore begins to receive letters from various self-exalted concerns, recommending him to do various things, to apply for foreign patents, or to permit the correspondents to act as his agents for the sale of his patent on commission.

"Many of these letters and circulars contain statements that are absolutely fraudulent. The inventor, for example, will be urged to apply for foreign patents in England, France and Germany, and other countries, when the agent is perfectly well aware that after the patent has issued in the United States and has been published in the Patent Office Gazette, valid patents cannot be procured in those countries, except under the International Convention, which he is seldom able to avail himself of. The patent shark relies upon the ignorance of this fact on the part of the inventor to protect him in his nefarious traffic. He is also protected from detection by the fact that in many foreign countries there is no examination as to novelty, and in due course, and after the payment of the government fees, the patent will issue and he will be provided with the letters patent certificate to present to his "client" who sleeps in blissful ignorance of the fact that the documents are not worth the paper they are printed on.

"In many cases the fees upon examination will be found to be phenomenally low and the inventor will snap at what seems to him a bargain, simply to find that in Germany, perhaps, he has procured a *gebrauchsmuster*, or model of utility patent, instead of a patent; or in Canada he may be led to believe that he has procured a patent for one year when he has simply filed a declaration of intention, which affords no true protection."

Many of the circulars sent out are artfully worded to convey the idea that the invention was accidentally come across and that its value was immediately apparent.

Inventors are usually sanguine and frequently fall into the trap so cunningly set.

Once an inventor falls into the hands of one of these firms he is exploited to the best advantage, and remarkably well plucked as many have found to their sorrow.

The moral of all this is—do no business with any firm issuing circulars tending to inflate the hopes of the patentee; have no dealings with any firm offering to sell a patent and asking for an advance, and in all patent matters consult only solicitors of good standing and proved integrity.

If Canadian inventors will heed the warning given by those in a position to give advice, they will save themselves much annoyance and much hardly earned money; at the same time the much desired result will be attained of rendering Canada an unprofitable fishing ground for Yankee patent sharks.

Yours, etc.

RIDOUT & MAYBEE.

A BOILER TEST.

BEFORE the Montreal Association of Stationary Engineers Capt. Wright presented a report of a boiler test recently made by him in that city, with a few prefatory remarks, as follows:

Before reading this report, I will make a few words of explanation. About two weeks ago I received a letter from a party unknown to me, requesting me to make a test of the steaming performance of a boiler in this city. I have met so many schemes to burn smoke and make boilers do impossibilities, that I am apt to look at new-fangled designs with suspicion. Yet it must be acknowledged that great improvements are possible. The fact that for every ton of coal you burn on a furnace grate, at least 16 tons of air go up the chimney at a temperature of 500 or 600 degrees, by which one-fifth of the total heat in the coal is absolutely lost, except in so far as it induces a draft, proves that at least in that direction, improvement is possible.

It is unfortunately the case, that this subject is often attacked by men who have not studied the question, and, moreover, are in ignorance of the usual practical methods of dealing with it, as far as the burning of wood or coal in a furnace is concerned. It was for these reasons that at first I had no intention of doing anything in connection with this proposed test. But, hearing who the interested parties were, I called on them, and decided to act.

The circumstances under which the test was made were uncommonly unfavorable—a rainy day, a leaky roof, a very poor article of coal, completely saturated with water. When I went there in the morning, no preparations for a test had been made. A Fairbanks scale was got, coal was weighed, a water barrel was mounted on the scale, and connections made from the service pipe to barrel, and from the barrel to injector. This took time, and at 10 a.m. the test began. At noon, after stopping for the hour, I ran over my notes and was surprised at the results. In conformity with the daily custom, the boiler tubes were swept out during the noon hour. What was then accomplished is contained in the report, which I will now read.

D. L. DWINNELL, Esq., City.

DEAR SIR:—According to your instructions, a test was made on the 26th ult., of the steaming qualities and general behavior of the boiler in the works of "The Montreal Toilet Supply Co." on Dorchester street, in this city.

The boiler is of the common cylindrical type with return tubes. The shell is 42" dia. and 11 feet long, with thirty-nine 3" tubes, and a grate area of 13½ square feet. The principal object of the test was to determine whether certain peculiarities introduced in the setting, increased the efficiency of the furnace, and the steaming qualities of the boiler. The test was made under the usual every day conditions of work and began at 10 a.m. ending at 4.50 p.m. Everything was taken as found; no change was made or cleaning done previous to the start. A bituminous lower port coal was used and was an inferior quality of what is known in the trade, as "Run of the mine." City water at a temperature of 34 degrees was alone fed to the boiler by an injector; the overflow water, in starting the injector, was returned to the barrel it came from. This barrel was mounted on the platform of a "Fairbank"

scale with water connections to and from. The change, or weight of water running to each barrel was the same, and the time when filled was carefully noted. The total weight of water fed to the boiler between 10 a.m. and 4.50 p.m., was 6864 lbs. Four barrels of dry coal was dumped in separate heaps on the floor, each heap weighing 238 lbs., a total of 952 lbs. consumed between the hours above named, and the time each heap lasted was carefully observed. In this manner any variation or irregularity is observed at once.

At the close of the test the ashes weighed 90 lbs. Deducting this from the weight of coal laid on the floor, leaves 862 lbs. of combustible or pure coal consumed between the above hours. During the noon hour, the boiler furnishes steam to the coil in the drying room and mangles, and 209 lbs. of water was fed to the boiler, and 32 lbs. of combustible consumed on the grate. This performance forms no part of the test in working hours, for if retained, would destroy the whole, and these amounts of fuel and water must be subtracted from the total between 10 a.m. and 4.50 p.m. and takes this form: Total combustible consumed on the grate between 10 and 12 a.m. and 1 and 4.50 p.m., 810 lbs. Total water fed to the boiler during the same time, at a temperature of 34 degrees, 6655 lbs., which is an evaporation of 8.216 pounds of water from a temperature of 34 degrees to steam at seventy-five by gauge, per pound of combustible burned on the grate, equivalent to an evaporation from and at 212 degrees, of 10.02 pounds of water per pound of combustible. This is the mean performance of the boiler during the working time of the test.

The gauge was kept very regular at seventy-five. The total absence of black smoke from the stack was remarkable. At times when fresh coal had been put on the grate, a thin grey smoke made an appearance for a short time, and generally on looking at the top end of smoke stack there was no visible proof that there was a fire under the boiler. At the close of the test the water level in the glass was the same as at the beginning. The uniform rate at which water disappeared from the boiler was surprising. During the working hours, both forenoon and afternoon, if 209 lbs. of water had been regularly fed every ten minutes to the boiler, the water level in the glass would have been practically the same during the working time of test.

But an unexpected change did take place. The thirty-nine tubes in the boiler were cleaned in the noon hour, and it was observed between 1 and 2 p.m. that the consumption of fuel was forty-seven pounds less than in any sixty successive minutes during the forenoon.

The method of conducting the test permitted this comparison. At first I thought there was an error, but if so, I failed to detect it, and it continued at the same rate up to the close of the test, notwithstanding the weight of water at a temperature of thirty-four degrees supplied to the boiler per hour, was practically the same both forenoon and afternoon.

Between 10.50 and 11.50 a.m. 1236 lbs. of water were fed to boiler and 174 lbs. of combustible was consumed on the grate. Between 2 and 3 p.m. 1237 lbs. of water were fed to boiler, and 127 lbs. of combustible consumed on the grate. This is at the rate of 9.74 pounds of water at a temperature of thirty-four degrees evaporated to steam at seventy-five by gauge, per pound of fuel burnt on the grate—equivalent to an evaporation from and at 212 degrees, of 11.87 pounds of water per pound of combustible burned on the grate.

The ashes were 9.45% of the weight of coal, and in conformity with all reliable and comparable tests of boilers, the standard results are calculated from the weight of combustible, and the equivalent evaporation from and at 212 degrees.

The boiler house appeared to be formed by a roof, built over a former alley way, between two adjacent buildings.

It rained steadily during the time of the test. The roof leaked and it was a difficult matter to find standing room in front of the boiler where water did not drop on my note book.

The coal used had been kept outside in a yard all winter, and contained lumps of ice, which of course, during the weighing of the coal were thrown out if observed.

In view of the results obtained during this test, it should be repeated under different conditions.

The whole respectfully submitted,

(signed) CAPTAIN JAMES WRIGHT.

Montreal, April 7th, 1896.

The residents of Beausville, Ont., are urging the extension of the Hamilton, Grimsby and Beausville Railway to that town, and it now seems probable that work will be commenced this season.

SPARKS.

The village of Westport, Ont., will probably introduce electric light.

Bothwell, Ont., is moving in the direction of securing electric light.

An electrical stamp cancelling machine is in operation at the post-office at Ottawa.

The St. John, N. B., Street Railway Company are extending their line to the park and cemetery.

The Canadian General Electric Co. have been awarded the contract for the electrical equipment of the Hamilton Radial Electric Railway.

The telegraph and telephone companies' cables were damaged at Three Rivers, Sorel, and other points on the St. Lawrence, as the result of spring floods.

The Lachine Rapids Hydraulic & Land Co. have decided to place their wires underground. The management have recently inspected systems of conduits in different cities in the United States.

A citizen of Quebec is said to have sent to Paris for an electric omnibus, which can ascend and descend hills with greater ease than one drawn by horses, and can do its sixty miles an hour comfortably on a level road.

It is said that the Maginn Power Generator and Motor Co., of Chicago, will shortly put upon the market a light motorcycle, the price of which will be only slightly in advance of that of a first-class bicycle.

The Steam Boiler and Plate Glass Insurance Company, of Canada, with head office at London, Ont., announce the transfer of their plate glass insurance business to Lloyd's Plate Glass Insurance Co., of New York.

The Upper Ottawa Improvement Co. are replacing their No. 14 copper wire, from Ottawa to Guyon, P. Q., a distance of 40 miles, with No. 9 galvanized iron wire. The construction is in the hands of Mr. Maurice Quain, electrician, of Ottawa.

The Brantford Operating and Agency Co. is applying to parliament for permission to change its name to the Brantford Electric and Operating Co., to increase the capital stock to \$50,000, and to purchase the franchise, assets and rights of the Brantford Electric & Power Co.

The directors of the Royal Electric Company have decided to proceed at once with the construction of the water power at Chambly, Que. It will be owned by the Chambly Manufacturing Company, in which name the charter now stands, and the proprietors, ten in number, have subscribed \$30,000 each. The Royal Electric retains an interest of \$200,000.

The Bell Telephone Company have made application to the City Council of Montreal for permission to lay underground conduits for their wires. The Standard Light and Power Company have certain privileges in this respect which were obtained some years ago, and the Council have decided to refer the matter to the City Attorney before taking any action.

The St. Martins Telephone Company, St. John, N. B., at their annual meeting, elected the following directors: Messrs. W. E. Skillen, John McLeod, Walter H. Allen, C. M. Bostwick and C. D. Trueman. The directors afterwards chose Mr. John McLeod as president; Mr. W. H. Allan vice-president, and Mr. A. W. McMackin as secretary and general manager.

The Hawkesbury Lumber Co., of Hawkesbury, Ont., have purchased a 25 k. w. dynamo of the Edison type for lighting the interior of their six mills, which were previously lighted by arc and series incandescent, from a 60-light Wood arc dynamo and 35-light Ball dynamo and which are now used to light their yards. The change is a decided improvement on the old system.

The following students were successful at the spring examinations at McGill University, Montreal: Electrical Engineering—Charles Harvey Wright, Renfrew, Ont.; Harry Alex. Chase, Kentville, N. S.; William Currie, B. A. Sc., Montreal; Homer Norton Jaquays, B. A., Montreal; Wm. Norton Cunningham, B. A. Sc., Montreal; Stewart Fleming Rutherford, Montreal. Mechanical Engineering—James Lester Willis Gill, Little York, P. E. I.; Francis Edward Courtice, Port Perry, Ont.; John William Hunter, Kingston Station, Ont.; Thos. Fred. Kenny, Ottawa; Ernest Randolph Clarke, Stratford; Henry Arthur Bayfield, Charlottetown, P. E. I.; George Alexander Walkem, Kingston, Ont.; Gordon Scott Rutherford, Montreal.

ELECTRIC POWER FROM THE MONTMORENCY FALLS IN CANADA.

By C. C. CHESNEY.

THE Falls of Montmorency, situated eight miles below the far-famed and historic city of Quebec, are the scene of one of the most interesting and successful electric transmissions of power in America. The cataract,



MONTMORENCY FALLS, SHOWING NOS. 1 AND 2 GATE HOUSES.

almost too well known to need any description, is the chief natural attraction in that vicinity, and while not possessing the magnitude of Niagara, there is yet something of the same grandeur and magnificence in the wild rush of its waters, and the same deafening roar that stuns for a moment the mind of the most stolid beholder. From a height of more than 275 feet the waters fall perpendicularly over the face of the rock, forming, in succession, furious cascades and seething pools in the ravine below, and rushing off to meet the waters of the majestic St. Lawrence.

It is the especial object of this article to call the attention of those interested in the general development of water powers, and especially of those who may have occasion to investigate the problem of the transmission and distribution of power by alternate currents of electricity, to the method and apparatus there used, in the belief that it is an object lesson, not only of scientific interest, but of great practical value.

To a people less conservative than the "habitant,"—less apt to revel in the memories of the shrouded past, utilitarian possibilities of this beautiful cataract might have appealed earlier, but with this mystic people, and within sight of one of the largest cities of Canada, the massive energy of Montmorency was

allowed to waste away for years in dashing itself into the chasm below.

It is but a few years ago that a company, organised in Quebec, constructed a dam across the narrow gorge in the Montmorency river at a point 1500 feet above the face of the falls, with the object of utilizing some of the power for manufacturing. A cotton mill was built at the foot of the bluffs, and shortly after, a small arc station was erected for the purpose of doing arc lighting in the city of Quebec.

In the year 1889 the present Montmorency Electric Power Company established, in connection with the arc plant, a small incandescent plant of about 100 horse-power capacity, using 2000-volt alternate current machines, built by the Royal Electric Company of Montreal, and transmitting the current to Quebec with a loss of over 50 per cent. This very unsatisfactory and uneconomical plan was continued until the summer of 1894, when a change of management brought to the service of the company the well-trying experience and engineering ability of Mr. Frank H. Badger, Jr., as general manager, and Mr. Louis Burran, as electrician, to whose intelligent work and attention to the practical details the final success of this plant is largely due.

Acting under the advice and direction of these gentlemen, the company increased the capacity of the old dam to a minimum of about 12,000 horse-power. A short tunnel was run through the solid rock, connecting the dam to the wooden flume which continues along the face of the adamantine bluffs for a distance of 1500 feet to the gate house on the brow of the hill. The construction of this flume was a task of considerable magnitude, involving the exercise of much engineering skill. From the gate house, on the brow of the hill, a steel-ribbed tube, having a diameter of 72 inches and a length of 1100 feet, is carried down a steep incline to the power house, where the pipe-line terminates in a large steel receiver which supplies the water to the turbines.



THE LIGHTING STATION, SHOWING 48-INCH STEEL PIPE SUPPLYING THE COTTON COMPANY WITH POWER.

Owing to the extremely high head and the great velocity at which the wheels must necessarily run, they were required to be very simple, stronger and more compact than is the general rule. The wheels adopted are the "Little Giant" turbines, manufactured by J. C. Wilson & Co., Picton, Ontario. The noticeable feature of these wheels, besides their simplicity, is the almost entire absence of lateral or end thrust, so frequently

found in the ordinary types. They have two sets of buckets, keyed on the same shaft, and the buckets are so formed that whatever end thrust there may be from the one set is counteracted by that of the other. The particular size installed at the Montmorency falls has a capacity of 700 horse-power and runs at a speed of 600 revolutions per minute. The "Little Giant" turbine is comparatively little known outside the Dominion of Canada, but some idea of its simple and compact nature can be gained from the fact that this 700 horse-power wheel is only 21 inches in diameter and has an extreme length not exceeding 2 feet.

The generating station is a two-storey structure, built of native stone, and is 150 feet long by 50 feet wide. It is situated in a picturesque and convenient spot between the hills and the Quebec, Montmorency & Charlevoix Railroad. The first floor of the building is devoted entirely to the turbines and the necessary gate mechanism. Along one side of the room the numerous wheels are arranged in a row, from which the belts proceed at an angle of 45 degrees to the dynamos on the floor above. The water is taken from the receiver in this same room and is discharged partly into the tail race which empties into the St. Lawrence river, and partly into the 48-inch steel pipe which supplies water to the wheels in the mills of the Montmorency Cotton Manufacturing Company.

The second floor is the dynamo room. It is a large, well ventilated and well lighted space, having practically the same dimensions as the building. To the practised eye of the engineer, it is at once apparent that the design and construction here have been carried out in accordance with the best engineering skill. It is unfortunate that electric lighting stations, as a rule, have been hurriedly constructed with any sort of material that happened to be near at hand, and equipped with that apparatus which was offered at the lowest price, regardless of quality. This room is, therefore, of more than usual interest, since in its equipment, or that proposed for future developments, every necessary improvement has been introduced which in any way promised to increase the reliability and efficiency of the plant, and to reduce the cost of operation.

The problem in electrical engineering which was presented to the Montmorency Electric Power Company is typical of the problems presented to all enterprises for the utilization of a waterfall by the transmission and distribution by electricity of its energy to distant points. The prime requisites in any such system for power transmission and distribution are, necessarily, simplicity and reliability. The simplicity and reliability of the single-phase alternating system are well known to all elec-

tricians and the electrical public in general. The system has been proven and tried in numerous cases where it has been the sole dependence of the larger enterprises, and where the practicability of transmitting power in bulk by this system has been demonstrated beyond question. It lacks, however, range and flexibility; it lacks a motor which commercially answers the requirements of power distribution; and it lacks the ability to be readily converted into direct currents for railroad and electrolytic work.

In the multiphase systems, however, which have been developed within the last few years by the various electrical companies, are to be found all these requirements. Coupled with the simplicity and reliability of the single-phase systems, are to be found range and flexibility. The induction motor forms the missing element for commercial power work, and extends its range far beyond that ever realized by the direct-current motor. When we now add the two-phase or three-phase rotary transformers, we have a system, ideal not only for long distance transmission purposes, but ideal for general central station work, whether the energy be primarily furnished by steam or water power.

Naturally, then, in order to obtain the most complete and commercial results from the power at its disposal, the system adopted by the Montmorency Electric Power Company is a multiphase system. The particular multiphase system is the S.K.C. (Stanley-Kelly-Chesney) two-phase system as applied by the Stanley



THE DYNAMO ROOM, MONTMORENCY FALLS POWER HOUSE.

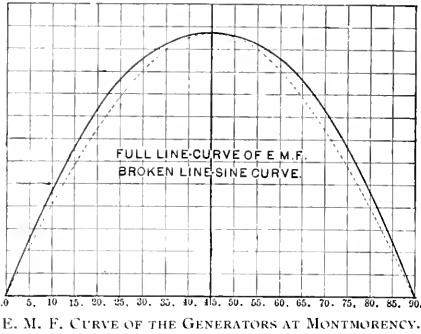
Electric Manufacturing Company, of Pittsfield, Mass., U. S. A., the Canadian (manufacturers being the Royal Electric Co., of Montreal.)

The generators are situated on the north side of the dynamo room. The foundations are of solid masonry, through which are run a number of tie rods which hold an insulating cap to the solid bed rock of granite. The insulating cap consists of 10 by 12-inch timbers which have been boiled in paraffine in order to completely remove all moisture. The bed plates of the machines are held in place by lag screws set into the paraffined timber. Each generator delivers alternating currents, differing in phase by 90 degrees, to two independent circuits at an electromotive force of from 5200 to 5700 volts. By means of rheostats in the fields of the generators, the electromotive force can be varied between these limits, to meet the requirements of the circuits.

The frequency is 66 periods per second—that is, the current is reversed approximately 8000 times a minute. The generators are what are commonly known as 8000-alternation machines. This frequency was selected as being one of the standard frequencies advocated by engineers of the Stanley Electric Manufacturing Company

and in preference to 133 periods per second (16,000 alternations); for, while the loss in the core of the transformers was increased from 20 to 30 per cent., and the regulation of the generators from a total of 2 per cent. to a total of 3 per cent., the self inductive drop in the transmission lines was such an important factor that the lower frequency was considered preferable, as giving, on the whole, a better regulating and more economical system.

The currents delivered by the generators are carried



by heavily insulated cables to the switchboard, where the attendant, by suitable switches, may connect the generators to the transmission lines. Two separate pole lines have been constructed to Quebec. One follows the route of the Quebec, Montmorency & Charlevoix Railroad, carrying two transmission lines, each having a capacity of 500 K. W.; the other follows the old Beauport road, carrying one transmission line of a capacity of 500 K. W., and provision for another line. All the lines are entirely overhead, and are entirely supported on wooden poles, with the exception that at the crossing of the Charles River they are carried across the river on iron poles, 125 feet high.

Triple petticoat porcelain insulators were used, and were made especially for this plant by a Canadian manufacturer, differing, however, but slightly from the design now in common use for high-voltage work. The line wire is No. 0, B. & S. bare copper. The drop, due to the ohmic resistance of the wire, is 8 per cent., which is increased by the self-induction to 10 per cent. On the extreme ends of the top cross-arms of each pole line are strung galvanized iron wires, which are grounded at every third or fourth pole.

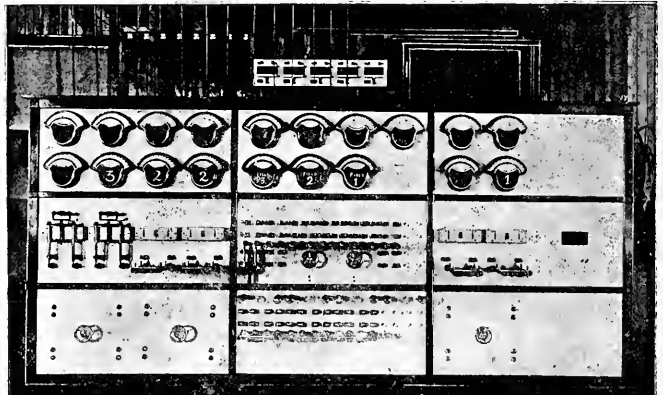
These iron wires, together with lightning arresters, placed at each end of the transmission lines, give a complete and safe protection from all lightning storms. So perfect has been this protection, that a discharge in either the generating station or sub-station is practically unknown.

The transmission lines enter the city of Quebec in that portion known as St. Rochs, and the sub-station is located in the centre of the industrial district, where power is needed for the tanneries and shoe factories for which the city is noted. The sub-station is 90 feet long by 65 feet wide, and is two storeys high, built of brick,

with a stone front. The building consists of a store-room on the second floor, the offices of the company in the front, on the first floor, with the room containing the distributing switchboard immediately in the rear. The transformer house is a part of the same building, but only one storey high.

The transmission lines enter the sub-station through the cupola to the high potential receiving switchboard, which contains special high-voltage switches. These switches are mounted on marble and are fitted with special self-enclosing boxes, which are intended to cut off any possible arc that may be formed on opening the 5,000-volt circuits.

From the transmission lines the current of the generators is carried to the step-down transformers, where the electromotive-force of transmission is transformed into the distributing electromotive-force of 2,000 volts. These transformers are the regular indoor type of the Stanley Company, and are arranged on a rack, in two tiers, five wide and two deep, in such a manner that the air has free circulation, or that they may be artificially ventilated if it be so desired. They are of 50 K.W. capacity, and are connected in pairs. Each is wound for a primary electromotive-force of 2,500 volts, and a secondary one of 1,000 volts. The primaries of each pair are connected in series for receiving 5,000 volts, and the secondaries in series for delivering 2,000 volts to the distributing system. This arrangement gives an additional safeguard by lessening the voltage on any particular coil, and in case of a burn-out in any one transformer, the other will carry the load for a time until the relay transformer can be cut in. The insulation of each transformer was tested with 10,000 volts. The regulation of each transformer from no load to full load is about 1 per cent. The average efficiencies of the entire transformer equipment, as shown by the shop tests, are:—



THE GENERATOR SWITCH-BOARD, MONTMORENCY POWER HOUSE.

Efficiency, full load,	97.8 per cent.
" halfload,	97.9 per cent.
" quarter load,	97 per cent.

The transformers are divided into two sets of eight transformers each, with a relay of two transformers which can be cut in or out without stopping the service. Three secondary distributing circuits are carried to the distributing board in the next room. Provision has been made, however, for two more circuits of the same capacity.

The current from the secondaries of the two sets of transformers is carried to the bus bars of the distributing switchboard, from which it is furnished to the numerous city circuits for light and power.

The generators are the S. K. C. inductor type of two-phase machines, running at 286 revolutions per minute. Each generator has a capacity, at 5,700 effective volts, of 100 amperes. They are the largest inductor machines that have ever been built, and are the first and only practical machines that have ever been constructed for such a high initial electromotive force.

The armature is stationary, consisting of two sets of laminated iron rings, connected by steel rods four inches in diameter. On the inner surface of each laminated armature ring are fifty-six grooves for receiving the armature coils. The weight of this portion of the machine is 42,580 pounds. The field or exciting coil is circular, 94 inches in diameter, and wound on two copper bobbins, each $4\frac{1}{4}$ inches wide, with a copper strip four inches wide and .026 inch thick. It is insulated between the layers with a special oil-cloth which is practically indestructible at temperatures under 150°C .

To the dynamo builder the advantage of constructing a field coil on such lines is very apparent. With a free circulation of air, and every turn of the winding being, for cooling purposes, practically in contact with the moving air, there is no possibility of overheating in any portion of the coil. The copper bobbin, absorbing all discharges, prevents any excessive rise of electromotive-force on the coil, which might be caused by carelessly, or, under extreme circumstances, intentionally, opening the field circuit under full charge.

There are, in all, 56

armature coils, 28 for each phase. The coils are small and were wound in a lathe. Each coil was carefully insulated to stand 15,000 volts before placing it in the armature. The insulation of the completed armature was tested, finally, with 12,000 volts.

The inductor, the only moving portion of the machine, is a steel casting, 43 inches long, and 84 inches in diameter, upon the periphery of which are two sets of polar projections of iron laminae, fourteen at each end. The weight of the inductor, including the shaft, is 28,470 pounds. The net weight of the completed machine is, approximately, 100,000 pounds.

In the operation of alternating current motors, and also of transformers, it is now generally recognized as important that the currents and magnetic fluxes should vary sinusoidally, for the more nearly such a condition is approached, the less are the losses and idle currents. A first step toward obtaining these conditions is the making of the impressed electromotive-force of the generator sinusoidal. The flux between a field pole and the opposite iron of the armature distributes itself, so that it is, at every point, inversely proportional to the reluctance of the gap at that point, or inversely proportional to the distance from the field pole to the armature iron; that is, the electro-motive force at any in-

stant, is inversely as the clearance. In order, then, to obtain an electromotive-force following the sine law, the pole faces of the inductors of these generators, as well as the pole faces of the inductors of all generators, manufactured by the Stanley Electric Manufacturing Company, are so shaped that their curvature may be expressed by a formula which was derived by Mr. Kelly, of the Stanley Company, and is contained in a United States patent issued to him.

In the design of the inductor machine it has been found by the writer than any deviation from this law, or the use of any other than a sinusoidal electromotive-force has resulted in increased losses in transformers and unsatisfactory running of motors. In one instance the output of a 20 h. p. motor was reduced 25 per cent. on a machine with a distorted wave, and the condensers which were intended to balance the lagging currents of the motor, were absolutely useless for that purpose.

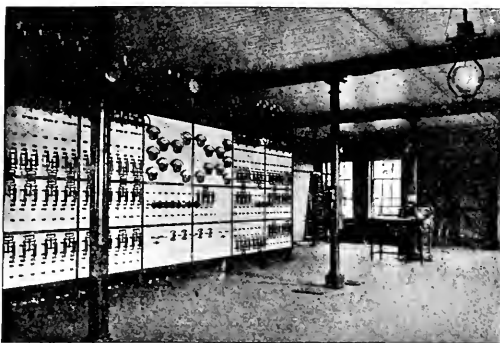
A novel feature has been introduced for the first time in these generators. The entire distributing system has been arranged to be run in parallel, and, in order to do this the generators must be kept in phase. There are some objections, however to paralleling 5,000 volt machines through their principal circuits—also do difficulties occur in paralleling long transmission lines. A defect arising in any wire of one line, such as a ground or leak, affects all the wires in all the lines, so that if at any other point another ground occurs, the generators between the two grounded points are all short circuited. To overcome this difficulty, the mains from the different machines are kept separate and the secondaries of the step-down transformers are connected in parallel with the supply mains.

In consequence, unless the line from one generator has two weak points, there is no leakage, and, at any rate, the leakage due to two weak points can affect directly only one generator. In order to keep the generators in phase under these conditions, a separate and distinct synchronising winding gives an electromotive-force of 120 volts and has a synchronising capacity of about 100 K. W. This, together with the effect that can be obtained through the parallel secondaries of the step-down transformers is sufficient to give perfect parallel running. The load can be readily shifted from one generator to the other by varying the quantity of water supplied to the turbines.

The exciters are two slow speed, direct current machines of 12 K. W. capacity, each of sufficient capacity to excite the fields of the three alternators.

Some of the electrical data of these machines are interesting, as showing the improvement in dynamo design and the possibilities of the inductor type of machine. From the shop tests we have the following:—

Maximum loss in field,	4000 watts.
Loss in armature iron,	20,000 "
" friction and windage	"
" armature copper	7000 "



THE DISTRIBUTING STATION, MONTMORENCY FALLS POWER HOUSE.

From these we calculate the efficiencies :—

Full load,	95.1 per cent.
Half load,	92.3 per cent.
Quarter load,	87 per cent.

The rise of temperature after a run of twenty-four hours, with full load, is as follows :

Field coil,	12° C.
Armature iron,	21 C.
Inductor iron,	7 C.
Armature coils,	26 C.
Bearings,	21 C.

The regulation, that is, the variation of the electromotive force from no load to full load, with same speed and same field excitation, was $3\frac{1}{2}$ per cent. With full load on one phase and no load on the other, the percentage difference of electromotive force was $3\frac{1}{2}$ per cent.

The design of the switchboards and the general features of their construction can be best understood by reference to the illustrations on pages 13 and 14. Both the generator and distributing switchboards are built of marble, supported upon wooden frames, and the panel method of construction is followed throughout. Each slab of marble was tested for metallic streaks, with a pressure of 12,000 volts.

The generator board consists of three sections, of three panels each. The lower panel of the left-hand section carries the two rheostats for controlling the fields of two of the generators. They are mounted on the back of the board, and only the handles and the heads of the supporting bolts show. The middle panel carries four machine switches with self-closing arc cut-offs, two for each generator, and one of these for each phase. These connect directly to two of the four-wire transmission lines.

It is never intended to open these switches under load, except in the case of great emergency, when the automatic cut-offs will take care of any discharge from the line, or any tendency to arc. When a generator is to be taken out of work, the load, if it is running in parallel with another, is shifted to the other by gradually cutting off the supply of water to its turbine; after that, the switch can be opened without difficulty. If the generators are running independently, the load is first transferred at the sub-station before opening the switch.

The upper panel contains four ammeters, two for each transmission line, and four voltmeters, with high-potential station voltmeter transformers placed directly at the back. The right-hand section is exactly the same as the left, with the exception that it is, at present, equipped for only one generator and transmission circuit.

The lower panel of the middle section carries three four-pole, single-throw switches for connecting the synchronising windings of the generators in parallel. The synchronising lamps are shown just above.

The middle panel is the exciter panel, carrying the necessary switches for paralleling the two exciters, and for charging the field of any generator from any exciter if the exciters are running independently.

The upper panel contains three direct-current ammeters for the fields of the generators, and also four alternating current voltmeters, with voltmeter transformer at the back, connecting to the 2,000-volt potential lines which return from the sub-station.

The distributing board was originally designed for parallel running only, but it was afterwards learned that on rare occasions ice accumulates in the turbine feed pipes, which affects the speed of the wheels and makes parallel running an impossibility. In consequence, the

original design was changed to permit either independent or parallel running of the generators. The two sections on the left of the board are organized for lighting alone, and to permit the transfer of any two-wire circuit upon any of the possible four sets of step-down transformers. This is accomplished by a series of three double-throw, double-pole switches. At the extreme top of this section are the automatic circuit-breakers. The two sections on the right of the board are organized for light and power, and differ from those on the left only in that the four-pole double-throw switches are substituted for the two-pole double-throw.

The two centre sections are the same in design. The upper panels contain the voltmeters and ammeters for the various circuits. The middle panels carry four-pole double-throw switches, and are connected to the secondaries of the step-down transformers in such a manner that, if the switches are thrown up, three sets of two-phase secondaries are connected to three separate sets of bus bars; if they are thrown down, all the secondaries of each phase are connected in parallel. The lower panel carries the ground detectors of the ordinary transforming type. The whole switchboard is 26 feet long and 11 feet high.

All the motors now in use by the Montmorency Electric Power Company are the S. K. C. induction motors. These motors were described by Dr. Bell in the January number of this magazine. They vary in size from one horse-power to 30 horse-power, and do all kinds of work, running the tools of carpenter and machine shops, driving the saws and wood-planers of planing mills, and handling the freight elevators in various mills and in wholesale warehouses with perfect satisfaction. It is now well understood that the magnetizing current of an induction motor lags behind the applied electromotive-force, and that a lagging current in practice involves considerable loss and expense, by necessitating the use of larger conductors and generating apparatus, while it seriously interferes with the proper regulation of the generators, and increases the normal drop of the line.

In the S. K. C. motor the magnetising current is furnished by condensers; the motor then takes current in proportion to the load. Two condensers are connected in multiple with the fields of the motor, and each has a capacity in amperes at the working voltage practically equal to the no-load current of each field of the motor. If there is no distortion of the current wave, the apparent energy taken by an induction motor with condensers is equal to the real energy.

An interesting example of the value of condensers on induction motors is shown in a small plant in New England. The generator was a 60-ampere two-phase machine, manufactured by one of the larger electrical companies, and was furnishing power to a number of small induction motors. The motors were doing all kinds of general factory work and running ten hours a day. The average load on the motors was about one-quarter of their maximum. The amount of current furnished by the generator to the motors was 52 amperes at 1,152 volts. The power factor was 0.505.

When the motors were supplied with condensers, the current was reduced to 28 amperes at 1,150 volts, and the power factor was increased to 0.863. The reason that the power factor was not increased to unity was the existence of harmonics in the curve of the electromotive-force of the particular machine in use.

As to the commercial efficiency obtained in this plant, it is interesting to note that, with the generator working at full load, for every 100 K. W. of energy delivered to the pulley of the generator, 95.1 K. W. are delivered to the line at the generating station; 87½ K. W. are delivered to the terminal of the step-down transformers, and 86 K. W. are delivered to the distributing mains of the sub-station.—Cassiers' Magazine.

ELECTRIC RAILWAY DEPARTMENT.

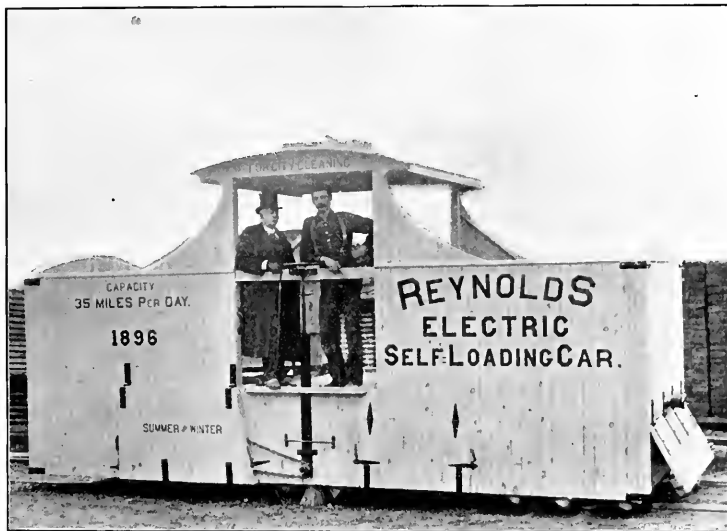
AN ELECTRIC SELF-LOADING CAR.

Mr. A. Jackson Reynolds, of Montreal, has patented an electric self-loading car for street cleaning purposes which is claimed to possess great mechanical ingenuity, and which promises to result in a large saving in the cost of cleaning city streets. The first car manufactured under his patents was turned out of the Rathbun Company's works at Deseronto a fortnight ago, and is shown in the accompanying illustration.

The system of cleaning is as follows: About one-third of the surface of the street is swept from the curb inwardly towards the railway tracks by the ordinary horse sweepers, driven in the opposite direction from the usual way of sweeping from the centre to the outside. The refuse is then taken up by the self-loading

instantly at any point desired. The brushes, steel casings, and rubber aprons are so constructed as to work in either direction automatically. The cars are driven preferably by a stationary motor placed directly over the brushes on the operating platform of the car, the brush being operated from a counter-shaft by sprocket wheels and chain.

The brush, which has been specially manufactured for the purpose, makes five revolutions to each one of a car wheel. It works much on the same principle as a carpet sweeper, and will throw the dust a distance of twenty-five feet. Its capacity is about twenty-eight car loads. The broom, which is fastened to solid heavy axles, is so arranged that it always fills the case in which it is contained, a simple but ingenious device



car at any desired speed and conveyed to the desired location.

The car shown herewith is 22 feet in length, 8 feet wide and 9½ feet high, very compactly and strongly built in every section. It is fitted with all the appliances for electricity common to a regular trolley car. Contrary to general use the brakes, motors, etc., are all situated above the wheels and axles so as not to impede the full action of the brush. The operating platform on which the persons stand while directing the motion of the car and broom is 8x5 feet, and so placed as to protect them from being touched by the dust thrown from the revolving brush or broom.

The results are accomplished mainly by placing a large rotary brush across the centre of a moving car, aid brushes being covered with steel casings, with proper outlets for discharging the sweepings into the body of the car, and covering the brushes with said steel plates, having rubber aprons fitting the pavements. The high speed of the brush forms a powerful suction, which takes up all the itemized matter and deposits it over the brush into the body of the car, which is provided with pivoted dump floors for dropping the load

changing the size of the latter to suit the changes made by the wear of material. The broom acts as well one way as another, steel deflectors being so arranged that it can be run backward without any change of machinery or even without touching it. By a change of the trolley the action may be reversed instantly so as to throw the dust one way or the other as may be desired. The broom may be extended so as to cover the whole street outside the car-track if necessary. For removing snow in winter the car may be constructed as long or wide as may be required. The car may be unloaded in thirty seconds, one man doing the whole work by manipulating a lever.

The cost of operating this electric sweeper is claimed to be about \$3.00 per mile. The side sweeping by horse machines can be done for \$1.50 per mile, which makes the total cost \$4.50 per mile. From \$15 to \$25 per mile is now paid by cities for the same work.

The price of cars will be \$1,000, with a royalty of one dollar per mile for all streets cleaned.

The inventor, Mr. Reynolds, now of Montreal, but formerly of Worcester, Mass., has had an experience of thirty-five years in the design and construction of

mechanical apparatus, having spent four years with the best engineers of Paris, London, Vienna, and other foreign cities. He is also the inventor of several other devices for which patents have been granted in Canada and the United States.

Mr. Jackson informs us that he has already entered into agreement with Ontario parties for the exclusive use of his cars in this province, for which privilege the consideration of \$45,000 is to be paid.

SPARKS.

The directors of the London Street Railway Company have authorized the issue of a larger amount of stock.

Work has been commenced on new car sheds for the London Street Railway Company, to cost \$7,000.

Work on the Hull and Aylmer road is progressing favorably. The first four cars will shortly be shipped from Peterborough.

During the year 1895 the Niagara Falls Park & River Railway carried 400,015 passengers. The receipts were \$65,784, and cost of operation \$40,630.

The Hull Electric Co.'s power house at Dechenes is completed, while the car shed, of stone, will be finished in a few days. Cars will be running before the 1st of July.

The Petrolia Electric Light & Power Co. are installing a direct current Canadian General Electric Co. power plant for pumping some oil wells near their power house.

The Gananoque Electric Light & Power Co. have increased their three wire incandescent plant by ordering two 600 light machines from the Canadian General Electric Co.

The Consolidated Railway and Light Co., of Vancouver, have ordered two additional open cars from the Canadian General Electric Co. The equipments will be of the standard C. G. E. 800 type.

C. G. T. Clark, superintendent of the electric lighting station at Niagara Falls, Ont., recently had a narrow escape from death at Tonawanda by coming in contact with a trolley while riding a bicycle.

Markdale, Ont. is to have incandescent light. Power will be obtained from a water power about one mile out of town. The contract for the plant has been closed with the Canadian General Electric Co.

The London Street Ry. Co. have placed an order for 12 additional C. G. E. 800 motors with the Canadian General Electric Co. This will make 60 motors of this type operating on the London road.

The ratepayers of Sherbrooke, Que., have sanctioned the construction of an electric railway along the streets of the town. Work will therefore be commenced at once, and the park line completed by fall.

Mr. C. A. Cunningham has entered an action in the courts against the Royal Electric Company, claiming \$10,000 for the loss of one of his eyes. The plaintiff met with the accident while in the employ of the Company.

The town of Listowel, Ont., has under consideration the question of installing an electric light plant. A committee of the Town Council has recommended that an electrical engineer be engaged to report on the cost thereof.

The earnings of the Montreal Street Railway Co., for seven months ending 30th April last, are \$661,543.86, against \$545,864.94 for the same period last year, an increase of \$115,678.92, giving an increase in the average daily earnings of \$543.10.

An electric railway company is applying for incorporation to operate in the city of Charlottetown, P. E. I. The city council has granted the company permission to operate cars on Sunday, which step is strongly opposed by the Ministerial Association.

The Hamilton, Chedoke & Ancaster Railway Co., who propose building a trolley line to run in connection with the street car system from Hamilton to Alberton, have requested a bonus of \$15,000 when the line reaches Ancaster, and the same amount when completed.

The date limit for the commencement of the electric railway at Quebec has expired, which involves the forfeiture of \$10,000. It is probable, however, that the City Council will grant an extension of time, Mr. Beemer having given assurances that the work will shortly be proceeded with.

The Port Daulhousie, St. Catharines & Thorold Ry. Co. have recently rebuilt their overhead line changing from the old Van Depoele over-running system to the standard under-running trolley. Additional motors of the C. G. E. 1200 type have also been purchased from the Canadian General Electric Co.

The work of constructing the new electric street railway system at Moncton, N. B., is proceeding rapidly. The Canadian General Electric Company have the contract for the apparatus, which includes a 100 k. w. generator and two double motors C.G.E. 800 equipments. The road is to be in operation by the 1st of July.

Work has been commenced on the electric street railway at Sarnia, Ont. It is the intention of the company to have one of the finest systems in Canada. The road will extend from Sarnia to Point Edward, and then to Weesbeach, a summer resort on the shore of Lake Huron. The city gave the company a bonus of \$10,000.

The cars of the Westminster and Vancouver Electric Tramway

Company have been improved and remodelled, under the supervision of Mr. P. M. Smith, the efficient manager of the road. The new Bessemer Sheet Steel Headlight, made by the United States Headlight Co. for the patentees, has also been obtained. This is said to be the most improved headlight obtainable.

Col. Stacey, who recently purchased the street railway franchise of St. Thomas, Ont., has made a formal proposition to light the city with 2,000 candle power lights and electrify the railway system. The price asked from the city is \$10,000 for the first three years, \$9,000 for the second three years, and \$8,500 for the following four years, the city to have the option of purchasing the plant at the end of that time.

At a recent meeting of the provisional directors of the Chatham City and Suburban Railway Company, of Chatham, Ont., there were present Messrs. John Mercer, G. P. Sholfield, Manson Campbell, John A. Walker, Fred Stone, Wm. Douglas, Q. C., and Geo. C. Rankin, London. Mr. Walker was appointed chairman of the Provisional Board, and Mr. Wm. Douglas, Q. C., secretary. It was decided to at once open a stock book.

Work has been commenced on the power house for the Hamilton Radial Railway Company at Burlington. It will be of brick, 53 feet by 100 feet, and will contain three boilers and two engines, each of 250 horse power. The chimney will be 14 feet in diameter at its base and 108 feet in height. Space will be left for additional engines and boilers should they be required. An effort will be made to put the line in operation by Dominion Day.

An exchange says that the enterprise of organizing a company to build an electric railway for Port Hope promises to develop into a definite scheme. Plans have been prepared which demonstrate that for a comparatively small expenditure an electric railway could be opened between Port Hope and Pontypool, thus connecting with the C. P. R., and extending a mail service to Kendall, Orono, Osaca and other places which are at present reached only by stage.

Dr. Oille, President of the Niagara Central Railway Company; Ald. J. S. Campbell and J. C. Rykert, of St. Catharines, and Mr. William McGill, of Thorold, recently waited on the Dominion Government requesting that the subsidy of \$100,000 standing to the credit of the road to Hamilton be diverted so that \$40,000 of it might be applied to the improvement of the existing roadbed and \$60,000 subsequently to an electric system connecting with the Toronto, Hamilton & Buffalo Railway.

The shareholders of the Moncton Street Railway, Heat and Power Company have elected directors as follows: J. L. Harris, president; J. W. Y. Smith, vice-president; R. A. Borden, secretary-treasurer; F. W. Sumner, E. C. Cole, J. C. Robertson, F. A. West, and Ald. Girvan. It has been decided to proceed at once with the construction of the road, and it is expected to have cars running in about two months. Stock to the amount of \$50,000 has been subscribed. The power house will be erected at the wharf siding at the foot of King street.

The Montreal Street Railway Company are again making extensive additions to their power plant. An order has been given to the Canadian General Electric Co. for a 1,500 kilowatt generator which will be coupled direct to a 3,000 horse-power Laurie engine. This immense unit, in which the weight of the generator alone will be nearly 100 tons, is similar in style to the direct-connected units supplied to the Toronto and Winnipeg Street Railway Companies. With the addition of the new machine, the capacity of the generator in the Montreal Railway Company's power house will exceed 8,000 horse power.

The incorporation is announced of the Cornwall Electric Street Railway Company, with a capital stock of \$150,000, the company being formed of H. R. Hooper, C. E., D. A. Starr, F. N. Seddall, and Mrs. Hooper, of Montreal, and W. R. Hitchcock, of Cornwall. At a recent meeting of the company, officers were elected as follows: H. Ross Hooper, president; D. A. Starr, vice-president and managing director; F. N. Seddall, secretary and treasurer. The construction of the railway has been commenced, and a portion of it will shortly be in operation. The cars are being built by the Rathbun Co., and the machinery by the Canadian General Electric Co. A powerful 120 horse-power electric locomotive will be used to haul freight, which will be one of the principal sources of revenue. A brick power house, 72 x 30 ft., is being built on Water street near the canal.

The annual general meeting of the shareholders of the Ottawa Electric Company was held at the company's office, corner Sparks and Elgin street, on the 1st inst. The report of the president and directors for the year ending April 30th was presented, showing a gross revenue of \$153,788.66, being a very satisfactory increase over the previous year. A dividend of eight per cent. was declared. The total number of incandescent lights installed is 53,331, an increase of about 5,000 during the year. The number of arc lights 497, motors 81, heaters 119. During the year considerable advance was made in the construction of a new switchboard under the direction of the general superintendent, Mr. A. A. Dion, which will result in a complete unification of the company's lines, so that the whole system may be controlled from the central lighting and power station. A vote of thanks was unanimously accorded the president and directors, and upon motion the board was re-elected as follows: Hon. Francis Clemow, Hon. E. H. Bronson, Geo. P. Brophy, T. Ahearn, J. W. McRae, Wm. Scott, C. Berkeley Powell, D. Murphy and Geo. H. Perley. At a subsequent meeting of the directors the following officers were re-elected: T. Ahearn, president and general manager; Hon. E. H. Bronson, vice-president; D. R. Street, secretary-treasurer; A. A. Dion, general superintendent; Redmond Quain and A. Bayly, auditors.

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PROCEEDINGS OF SIXTH ANNUAL CONVENTION.



THE Sixth Annual Convention of the above Association was opened in the Council Chamber of the Board of Trade Building, corner of Yonge and Front streets, Toronto, on Wednesday, the 17th June, 1896, at 2:30 o'clock, p.m. Mr. A. B. Smith, the President, presided.

The following persons were in attendance :

K. J. Dunstan,	Toronto, Ont.	A. Knowles,	Toronto, Ont.
J. A. Kammerer,	"	Irving Smith,	"
John C. Gardiner,	"	E. K. M. Wedd,	"
J. J. Wright,	"	W. A. Johnson,	"
J. Norman Smith,	"	J. K. Johnston,	"
F. C. Armstrong,	"	James Milne,	"
A. E. Payne,	"	T. F. Dryden,	"
Wm. Bourne,	"	P. G. Gossler,	Montreal, Que.
James Orr,	"	Fred. Thomson,	"
J. F. H. Wyse,	"	John Carroll,	"
George White-Fraser,	"	James A. Baylis,	"
J. W. Campbell,	"	H. R. Leyden,	"
Ed. D. McCormack,	"	J. Rogers,	London, Ont.
J. J. Ashworth,	"	Charles B. Hunt,	"
A. M. Wickens,	"	John Yule,	Guelph, Ont.
A. A. Christie,	"	Wm. Williams,	Sarnia, Ont.
George F. Madden,	"	W. B. W. Armstrong,	Parry Sound.
T. W. F. Hilliard,	"	George Black,	Hamilton, Ont.
F. C. Robertson,	"	B. J. Throop,	"
C. P. Dwight,	"	M. W. Hopkins,	"
H. P. Dwight,	"	E. Carl Breithaupt,	Berlin, Ont.
E. B. Biggar,	"	J. W. Howry,	Fenelon Falls, Ont.
F. B. Moore,	"	E. E. Cary,	St. Catharines, Ont.
Joseph Wright,	"	G. A. Powell,	"
J. S. Robertson,	"	W. G. Bradley,	Ottawa, Ont.
T. R. Rosebrugh,	"	D. Elliott,	"
Alex. Stark,	"	S. Rose,	"
W. J. Clarke,	"	A. A. Dion,	"
F. C. Maw,	"	D. H. Keeley,	"
W. R. Evans,	"	J. W. Taylor,	"
A. B. Smith,	"	O. Hignan,	"
C. H. Mortimer,	"	C. S. Mallett,	Peterboro', Ont.
F. J. Ricarde Seaver,	"	John C. Grant,	"

The President called the convention to order and stated that the first thing on the programme was the President's address, which he assured the members would be very short. He then addressed the convention as follows :

PRESIDENT'S ADDRESS.

GENTLEMEN OF THE CANADIAN ELECTRICAL ASSOCIATION :

It is with great pleasure that I meet the members of this Association at the present convention.

It is rather unfortunate that we were compelled by force of circumstances to hold our convention about the time the country is engaged in a political contest. This has undoubtedly prevented the attendance of some of our most valued members, but I hope, nevertheless, that our meetings will be as interesting and enjoyable as on any former occasions.

The papers to be presented promise to be of great interest in connection with subjects of the utmost importance to the electrical fraternity.

We are particularly fortunate in our place of meeting, and are indebted to the officers of the Toronto Board of Trade for the privilege of our pleasant surroundings.

As but a comparatively short time has elapsed since our last meeting, there is not much of actual achievement to chronicle, but there have been developments in the electrical field that indicate the possibilities of a revolution in our method of producing light by electricity. Many minds have for some time past been

occupied with explorations in this promising direction. The production of light without heat has a fascination for the inventor that will probably lead to tangible results in the very near future. The ordinary developments of the science as exemplified in modern systems of power transmission, and electrical construction generally, have advanced towards perfection in as great a degree as in former years, but the field for the enterprising inventor, so far from being exhausted, appears to be growing broader and ever broader with unlimited possibilities.

Notwithstanding the commercial depression, electrical industries in Canada may be said to be in a flourishing condition. The larger electrical manufactories are in full operation, and report a large increase in the output, and with many contracts on hand. It is likely that during the coming year their capacity will be considerably increased. The wonderful increase in the use of electricity for all purposes necessitates the installation of larger units. Dynamos that were considered colossal a few years ago are now being abandoned on account of their lack of capacity. This is leading to the equipment of the factories with more modern and powerful machinery for their production. The allied trades of the tool builder, machinist and engineer are all therefore receiving the benefit of this development of the electrical age.

Not the least of the current developments is the remarkable increase in the number and mileage of electric railways. The electric motor, a short time ago considered as limited to urban and suburban work, is now usurping the functions of the steam locomotive, and it is not too much to say that ere long we may expect to see it on our main lines of railway.

In other branches of electrical work good general progress has been made in perfecting systems and methods at present in use, both electrically and mechanically. The telegraph, with its adoption of new and rapid self-recording apparatus, and the telephone, with its improvements in long distance transmission of speech, are fully keeping pace with improvements in other departments.

The Association is to be congratulated on the promising outlook. It is likely that in the immediate future, with an improvement in the financial world, and as disturbing elements are eliminated, the developments will be even more rapid than in the past, and an era of greater prosperity than ever will be abundantly realized.

The President's address was greeted with applause.

The Secretary read the minutes of the fifth annual convention, which were confirmed.

The Secretary also read the Secretary-Treasurer's report as follows :

SECRETARY-TREASURER'S REPORT.

During the year covered by this report, the Association has made satisfactory progress. During the Association year beginning 1st June, 1895, and closing 31st May, 1896, there were added to the membership roll 24 active members and 4 associate members. During the same period 8 active and 7 associate members tendered their resignations, leaving the net gain in membership, 13.

Since the close of the Association year, there has been elected 21 active members, making the present membership 194 active members and 35 associates, a total of 227.

There are on the roll a considerable number of persons who, without having resigned their membership in the Association, have ceased to take an active interest in its affairs, and have likewise failed to pay their membership fees. It should be understood that when a person joins the Association, he thereby becomes a member, not for one year only, but until such time as he formally resigns his membership, and that until his formal resignation is received by the secretary and accepted by the Executive Committee, he continues to be liable for payment of the annual fee. It is perhaps due to the lack of a definite understanding on this point that the actual standing of the Association, with regard to its bona fide membership, is at the present time somewhat uncertain. The time has arrived when definite action should be taken to put an end to present and future uncertainty with regard to this matter.

It was to be expected that some of those, who at the outset became members of the organization, without being actually interested in the work which it is designed to accomplish on behalf of the electrical interests, would soon drop out. In the place of such, the Association has within the past two years been receiving as members, persons connected with the various departments of electrical work, and who therefore feel the benefit to be derived from connection with the organization and have a personal interest in its welfare. It thus appears that, while for a time, the additions to the membership may be in a measure offset by the withdrawal of members of the first mentioned class, the Association is steadily gaining in character and influence.

The annual conventions, which have been extremely interesting and enjoyable from the commencement, are becoming more so year by year,

in proof of which I need only point your recollection back to the delightful meeting in Ottawa last autumn, and direct your attention to the character of the programme on this occasion. Two meetings of the Executive Committee have been held since the close of the Ottawa convention, viz.: on the 22nd of October, 1895, and the 10th of January, 1896. At the first of these meetings, accounts in connection with the Ottawa meeting were examined and ordered to be paid, and the secretary instructed to have printed 500 copies of the revised constitution. At the second meeting two active members were elected. Messrs. Wright, Breithaupt and the president were appointed a committee to endeavor to make arrangements for a popular scientific evening lecture in connection with the present convention. The selection of a suitable place of meeting for the convention was left in the hands of the Toronto members of the Executive. The secretary was instructed to make request of the following persons for papers on the subjects named: Mr. O. Hignman, Ottawa, "Lamp Tests"; Mr. P. G. Gossler, Montreal, "High Potential Underground"; Mr. J. M. Campbell, Kingston, "Long Distance Power Transmission"; Mr. Charles P. Dwight, Toronto, "Ocean Cables"; Mr. F. C. Armstrong, Toronto, "The Future of the Electric Railway"; Mr. James Milne, Toronto, "Meters"; W. McLea Wallbank, Montreal, "Utilization of the Power of the Lachine Rapids"; Mr. George Black, Hamilton, "Acetylene Gas"; C. F. Medbury, Ottawa, T. R. Roseburgh, George White Fraser and E. J. Philip, Toronto, subjects not named. Mr. J. J. Wright was appointed a committee to ascertain whether a suitable steamer could be chartered for an excursion and dinner in connection with the annual convention. The sum of \$25.00 was placed at the disposal of the Committee on Statistics. The Toronto members of the Executive were appointed a committee to perfect local arrangements for the convention.

Following is a statement of the receipts and disbursements for the year:

FINANCIAL REPORT FROM 1ST JUNE, 1895, TO MAY 31ST, 1896.

RECEIPTS.	
Cash in bank June 1, 1895.....	\$186 77
Cash on hand June 1st, 1895.....	
93 active members' fees at \$3.00.....	279 00
14 associates at \$2.00.....	28 00
Refund by Statistical Committee.....	23 62
	<hr/> \$517 39
DISBURSEMENTS.	
Expenses of convention at Ottawa.....	\$218 92
By cash as per local committee statement.....	\$100 00
" caretaker at Ottawa.....	3 00
" express charges on books to and from Ottawa.....	1 40
" Canadian Electrical News, printing.....	72 50
" Canadian Photo-Engraving Co.....	16 22
" A. F. Sladen, stenographer.....	25 80
	<hr/> \$218 92
Electrical News for printing.....	7 00
Postage.....	35 10
Exchange on cheques.....	1 50
Blackhall & Co., 50 leather certificate covers.....	4 00
Grant to secretary.....	50 00
Mortimer & Co., badges, including protest charges.....	17 16
Grant to Statistical Committee.....	25 00
	<hr/> \$358 68
Cash in bank, May 31st, 1896.....	157 21
Cash on hand, May 31st, 1896.....	1 50
	<hr/> \$517 39

RECEIPTS SINCE MAY 31ST, 1896.	
June 1st, 1896, cash on hand.....	\$ 1 50
38 active members' fees at \$3.00.....	114 00
1 active member's fee at \$5.00.....	5 00
3 associate members' fees at \$2.00.....	6 00
Cash for exchange on cheque.....	15
	<hr/> \$126 65
EXPENDITURES.	
Ribbon and pins for badges.....	\$ 2 88
Receipt forms.....	40
Postage.....	20 78
Exchange on cheques.....	1 15
Envelopes.....	15
	<hr/> \$25 36
Cash deposited in bank since June 1st, 1896.....	95 15
Cash on hand June 17th, 1896.....	6 14
	<hr/> \$126 65

Total standing to credit of Association, June 16, \$258 50.

Certified correct,

B. J. THROOP } Auditors.
A. A. DION }

On motion of Mr. Dunstan, seconded by Mr. Kammerer, the report was confirmed and adopted.

The President: The next thing will be the reception of reports from committees. Mr. J. J. Wright will report for the Committee on Legislation and Mr. E. C. Breithaupt for the Committee on Statistics.

Mr. Wright: There not having been any legislation either in the Dominion or Local Houses that would

affect electrical interests in any way, the Committee on Legislation have no formal report to make.

Mr. E. C. Breithaupt read the report of the Committee on Statistics, as follows:

REPORT OF THE COMMITTEE ON STATISTICS.

Your committee beg to report as follows:—The committee endeavored during this year to carry into effect the idea expressed in the report of last year's statistical committee as to the compilation of data relating to central stations for the supply of electric light and power. To this end we drew up a blank form, requesting information on the following points, namely: motive power, station apparatus, station output, running time of station, and prices obtained. Information regarding the original cost of installation and cost of operation was not asked for, because it was deemed advisable not to make the form too long and complicated, but it was thought that if a proper interest were shown by central station men in the compilation of these statistics, they might at a later date be filled out more completely. There is no doubt that complete statistics of the central stations for the supply of electric current throughout the Dominion would be a reference book of no small value to all persons connected with the industry, and the committee have given considerable thought as to how this idea could be best put into practice. It has been thought that the formation of a sort of bureau of statistics, kept in the archives of the Association, to which any active member could have access, would best serve the end in view. The committee recognize that there is considerable information concerning the operation of a plant which proprietors cannot afford to have made public; the more general data, such as first cost of plant and particulars concerning the plant and apparatus, could be kept on file in the secretary's office and revised annually, so that any member of the Association could, on application to the secretary, obtain whatever general information he might want for his private use. Particular data should of course in each case be obtained personally, and it is fair to assume that between members of the Association, where the person requesting information and the object are known, it would be cheerfully given. The committee are of the opinion that a scheme for the compilation of statistics somewhat in the nature of a bureau of mutual information, as above outlined, would be a valuable adjunct to the work of the Association, and respectfully recommend its consideration.

Of the blanks sent out only a comparatively small proportion were returned, and in some instances were not filled out so completely as they should have been. However, the returns received would form a fair basis on which to continue the work. Because of the incompleteness of the returns the committee have not considered it advisable to draw up a tabulated summary.

The statistics received bring to light some interesting facts. Of the total number of replies received only three are from municipal plants; 12 companies only state that they supply current for power purposes, and two only supply current for heating; one for electric welding.

One fact which is particularly prominent is that the majority of the smaller stations are operated only during a very short period every 24 hours, mostly from dusk till midnight. In most of these cases it is probable that a sufficiently large motor load could not be obtained to employ the station during the day-time.

The committee do not consider that the work which they have done is in any way finished, and strongly recommend that it be continued during the coming year.

All of which is respectfully submitted.

E. CARL BREITHAUPT, Chairman.

On motion of Mr. F. C. Armstrong, seconded by Mr. J. J. Wright, the report was received and allowed to stand until Thursday, the 18th June, for consideration.

GENERAL BUSINESS.

The President read a telegram from Mr. L. B. MacFarlane, 2nd Vice-President, as follows:—"I sincerely regret that I cannot attend convention. Hope meeting will eclipse all former ones"; and stated that he was sure that all the members of the Association present would regret Mr. MacFarlane's inability to be present.

The President called the attention of the members to the banquet to be held at Lorne Park on the following evening, and requested them to inform the Secretary as soon as possible of their intention to be present. He also urged on the members to be present with their friends at the lecture on "Radiant Matter" to be given by Mr. James Milne in the rotunda of the Board of Trade building in the evening, as it would be an encouragement to Mr. Milne and the officers of the Association.

The President: While I am on my feet, and before proceeding with the consideration of the first paper to be read, I desire to say that it is quite gratifying to the Executive of the Association that so many new members are coming in, especially central station men. There were twenty-three new members elected, and I think about twenty of them are central station men. That of itself is very gratifying, and shows that the Association is fulfilling its mission. I hope to see more of them.

The first paper on our list is "Ocean Cables," by Mr.

C. P. Dwight, of Toronto. I am very sorry we will have to dispense with this paper. Mr. Dwight made an earnest effort to have it ready, but he found that the data necessary to give us an authentic, clear and concise history of ocean cables was so obscure, and required so much digging out, that he has not been able to complete it. I hope at some future time we will be favored with it—perhaps at the next convention.

We will pass on now to the paper on "Acetylene Gas," by Mr. George Black, of Hamilton. (See page 141).

Mr. Black, on rising to read his paper, said: Mr. Chairman, in coming away in a hurry I forgot two things. I forgot my paper (although I find it printed here), and I forgot some matches; so, if the gentlemen here have a supply of matches on hand I hope they will take up a collection in the meantime.

After the reading of the paper, Mr. Black gave a demonstration of the light produced from acetylene gas by means of a small apparatus which he had improvised for the purpose, and which he explained the working of to the members present. He stated that they were, in this demonstration, competing with the sunlight, and it was hardly a fair test.

Mr. J. J. Wright: I would like to know the pressure you have on.

Mr. Wickens: I think the pressure is less than half a pound.

Mr. Black: This gives the yellow flame because it does not oxidize sufficiently. I may say in the course of the next two or three weeks Mr. Willson's factory will be in full blast, and I understand he is going to light up St. Catharines. Several establishments will have the gas pure to show the results, so that all who are interested can visit St. Catharines to see it for themselves.

Mr. F. Thomson: Is there any place where they are actually using this gas?

Mr. Black: Not as yet.

Mr. Thomson: They have been making it for the last couple of years back.

Mr. Black: Just experimenting. A number of factories have been watching to see the result of the Niagara Falls output before they start.

Mr. Thomson: They have been manufacturing since May.

Mr. Black: Since May.

Mr. Thomson: Some of that ought to be used.

Mr. Black: It requires a good deal to make a contract with a town, and you have to have a good supply to keep it up, and not run out of it.

(At this point the electric light in the room was turned on, and comparisons made with the acetylene gas.)

Mr. Wickens: The globes on the electric light kill forty per cent. of the light, whereas the acetylene gas is a bare light.

Mr. Black: I have had it without the slightest trace of yellow color, and with just a blue spot about the size of a pinhead.

Mr. Wright: I understand that Mr. Black informs us that Mr. Willson proposes to use that gas in St. Catharines as a mixture or energizer to the ordinary gas. In the paper I notice that he says that it does not mix very well with the water gas; in fact, it is no use for that; it will mix better with coal gas. We all of us know, I think, that there is precious little coal gas manufactured. Very nearly all the gas companies are running with water gas. If that is really the case there does not appear to be very much field for this product as an energizer for the ordinary gas of commerce, as we may call it. The gas companies, for the sake of using it, save as an energizer, would never exchange their water gas plants and go back to the old methods of producing coal gas at a vastly greater expense in order to use acetylene gas, which is manufactured at a tremendously low rate. My remarks are with reference to gas plants all over the country. We are all aware that the largest gas plants are water gas plants.

Mr. Black: I don't know anything about the condition of the gas companies. In Hamilton I know it is coal gas which they make. I understand in Toronto it is water gas.

Mr. Wright: Both.

Mr. Johnson: Is there any difference in using iron, brass or copper tubing? Does it cause any trouble by using the brass or copper?

Mr. C. S. Mallett: I believe it combines with copper and makes a kind of deterioration; it uses up the copper, I understand. It also does with brass, but not to such an extent as to interfere with any fixtures like those (refers to fixtures used by Mr. Black in illustrating the acetylene gas.) On iron or lead it has no effect.

Mr. J. J. Wright: If there is a deteriorating effect and the copper would combine with the gas, that would certainly seem to rule out the fixtures at present in use. You could not guarantee that any brass fixture has not got a large proportion of copper in its composition. It appears that if this gas were used even as an enricher for ordinary gas, and used in an ordinary fixture, that the whole thing would have to be revised; new fixtures would have to be put in all over. Would not that have a tendency to shut it out as an energizer of ordinary gas?

Mr. Black: Have not all fixtures an iron pipe inside, for gas? I think the conducting pipe is iron.

Mr. Wright: Any number of gas fixtures are made of copper and brass piping.

Mr. Black: The parties who are running it do not think they will have any trouble.

Mr. Wright: They are rather too optimistic as to the outcome of this product. We are well aware that the true test of the merit of any new discovery is its use. It is two years now since Mr. Willson first discovered this gas; and we do not find that it is in use in any commercial or practicable sense. They have been making preparations in various places to experiment with it and that is about all. If this had been such a valuable energizer, as the making of it is such a very simple process, it certainly would have come into use to a very much greater extent than it has. I think you can look upon that as the true test of any new discovery.

Mr. Black: Anyone who makes such a discovery as this wishes to secure it as safely as possible before giving it out to the public. It takes a lot of capital to work a thing of that kind; it takes time to interest capitalists; it had to be tested in every possible way; they had to be satisfied by chemists and others that it was all right before they put their money in it. I have no doubt but that within the next six months you will see plenty of it.

Mr. Mallett: Why is it those three jets have lost a great deal of their illuminating power?

Mr. Black: We have stopped the generation of the gas and the pressure is taking care of itself. We might as well turn it out, but we wish to burn up the gas. Where you see the yellow flame it shows an excess of carbon.

Mr. Breithaupt: The paper we have listened to by Mr. Black is certainly one of great interest to all the members of the Association, and I think we should congratulate Mr. Black upon presenting the subject in such a concise and clear manner. The question of acetylene gas is one which is creating a great deal of interest throughout the country at the present time. I may say I have studied it up a little myself, and have data of tests that were made by two engineers of the Acetylene Gas Co., in Philadelphia, the company which is there exploiting this matter principally, I believe. These tests were made in North Carolina, before the three experts, Professor Houston, Dr. Kennelly and Dr. Kinnicutt made their tests, and they were not so favorable as the tests made by the three experts in March last. Of course we may expect in that time (it was nearly a year before that the other test was made) there was some improvement made. The cost of acetylene gas varies directly at the cost of producing the calcium carbide. The figures here given as to the cost of calcium carbide I think are altogether too optimistic. In the report of the test made by Professor Houston and Drs. Kennelly and Kinnicutt the cost of power is given as \$5 per h.p. We all know that \$5 per h.p. per annum is a figure that nobody ever dreams of,

much less realizes. I am surprised that the rate mentioned has been secured at St. Catharines. Of course, if that is so the argument drops.

Mr. Black: About 200,000 h.p. is available in the province of Quebec at the same price.

Mr. Breithaupt: It is a price that is surprising, because nobody who has been in the business at all has known any such price. At Niagara Falls, where they are producing power in such enormous quantities, they are selling it at \$20 per h.p. delivered at the works only. Therefore, one argument that is made throughout, that the production of calcium carbide can be utilized as an additional load to the ordinary small station, drops. The ordinary small station cannot deliver power at anything approximating \$20 per h.p. For instance, here in Toronto or elsewhere where power has to be generated, from steam, the difficulties of using this gas as a pure illuminator would be great. Could this gas be controlled and distributed through pipes, if it were generated in a private house and be burned there just as it is generated? The Acetylene Company in Philadelphia were exploiting a system of generating directly in the place where it is to be used. They have for that purpose a generator similar in principle to what Mr. Black has here, just a box in which they keep the calcium carbide; they apply water to it and the gas goes from the generator directly into the house pipes. The great question is, how to regulate the pressure. The affinity that this compound shows for water is very great. I understand that once you have turned on a certain amount of water you cannot stop generation of the gas until that stock of water is completely exhausted. I was speaking to engineers in Philadelphia about it and I asked them how they regulated it. They said the only way is to let the gas escape, or else the pressure will get to such a height as to be dangerous.

Mr. Black: They have a safety valve, and if the pressure rises above a certain point it blows off.

Mr. Breithaupt: That would be wasted energy. As to the use of acetylene as an enricher for coal and water gas, I read a paper by Prof. Lewes on that point, and he said the gas does not mix properly with the water gas and is of very little value there. It is, however, a good enricher for coal gas. The commercial value of acetylene gas, taking all these points into consideration, it seems to me is not quite so promising as its promoters claim for it. There is another point to which Mr. Yule has called my attention with reference to laying pipes to distribute acetylene gas from a central station. At present, in laying distributing pipes for gas, we put the pipes below the frost line, not only to prevent condensation, but also to keep our pipes intact. If you lay pipes above the frost line the frost will soon break them. You must take into consideration that however you place these pipes, you have got to put them below the frost line in order to keep them intact, and then you would have just as much cost in laying as in laying ordinary gas pipes.

Mr. A. A. Dion: I have listened to Mr. Black's paper with a great deal of interest. It is a very good paper. But, I must say I am still in the same position that I was before; I am not yet able to make up my mind as to the true cost of acetylene gas, or its true value. I have read nearly everything that has been published in the technical journals concerning acetylene gas in recent years; and I have read with a great deal of attention, trying to form an opinion as to the real cost of producing the calcium carbide and also the true value of the gas as a possible competitor with electric lighting, but I found those articles so contradictory that it was impossible for me to form any opinion whatever, and I am still in the same position. I think, however, that Mr. Black's views of the prospects of acetylene gas are much too rosy. However, those of us who might have formed the opinion, as I had, that the gas was very poisonous, are consoled with Mr. Black's statement that it is not so poisonous as coal gas. I think it might be very much less poisonous than coal gas and still be very objectionable to most of us in that respect. Another thing: he argues that its strong

pungent smell is a safeguard, and a person could not go to sleep before noticing it. We know that the ordinary illuminating gas has a very strong pungent smell, nevertheless accidents do happen. There is the further objection, that there is nothing necessarily alarming about the smell of garlic. There is one thing I wish to call your attention to, which is, I think, perhaps a misprint; Mr. Black states in his paper that the pipes can be laid below the surface for little or no expense. I cannot conceive of a case where no expense would be incurred.

Mr. Wickens: There is one matter that Mr. Briethaupt spoke of which was demonstrated here, while we were experimenting with the gas. The gas generates very quickly, as soon as the water strikes it; it is absolutely necessary to hold the meter down pretty well; it lifted it right up. It is hard to tell how to accommodate the pressure. It is evident it would be very troublesome to regulate the speed at which this gas is to be generated and delivered into a tank. You noticed that if we increased the pressure on the gasometer the light would flare up. As long as the pressure was at the same fixed point the light was steady, and as soon as we put a little extra pressure on it made the light considerably stronger. It is evident it is going to be very difficult, if it ever is accomplished, to exactly regulate the pressure, from the fact that the gas generates very rapidly and you could not tell when it is going to stop. After the color disappeared in the jar it was still making gas—it was still pushing against the counterweight.

Mr. Yule: I do not see any difficulty in overcoming the objections that Mr. Breithaupt makes. Supposing you have a fifty pound holder in your cellar, you will know how many pounds you can make from so many pounds of acetylene—making your gas in the afternoon before you start—and you simply use up your holder. Your pressure will be the same throughout the evening if your holder is of sufficient capacity to supply you with gas during that night. It is not necessary to make more gas while you are using it. So many pounds of acetylene will make so many feet of gas; it is simply the operation of leaving it stand there and using it in the night.

Mr. J. F. H. Wyse: Wouldn't that of itself be an objection to having the gas in the house if you had to depend on the domestic to make the gas in that way? It seems to me to be a serious objection. The master of the house would not want to have to look after a matter of that kind.

Mr. Wickens: Suppose we make a gas receiver or receptacle in that house. We know it we have so much water we are going to make so many feet of gas; the receiver will be of some fixed size and the pressure so much per square inch; we start our lights around the house, and if we use two-thirds of the gas generated we have made the receiver no smaller and the pressure has gone down.

Mr. Hopkins: I don't think that is so at all. That would not necessarily follow.

Mr. Armstrong: It is the running and regulating of the generator of acetylene from calcium carbide in what we might call the small unit which Mr. Willson seems to favor, but the difficulty would seem to be that it is not something that the ordinary domestic could be expected to handle in a satisfactory way. The possibility of danger and the difficulties are certainly greater than with the ordinary furnace, and they are generally found sufficient; and it seems to me unlikely, accustomed as people are now-a-days to depend on the central station or gas plants, that they would be disposed to have any bother. One thing which seems to have been left out of consideration is the fact that the calcium carbide for shipment must be put up in closely sealed packages, and when these are opened, on exposure to the air, it deteriorates very rapidly. Mr. Willson did not seem to favor the idea of distribution when liquefied under pressure in cylinders; he did not state for what reason, but I fancy it is on account of the danger of explosion when under high pressure, which I believe is very great. There is another point in connection

with the gas which I think should not be overlooked, and that is, when the temperature is raised to about 300 degrees it becomes highly explosive, and in case of general use and in the case of fires that would become a very serious drawback to its use. It seems unnecessary to say anything about the estimates of cost which have been given. I think as yet they are not based on any ordinary commercial values, which we would require to have established before it could have any extended use. There is one small item which I see is entirely omitted in the calculation of the cost as given by Mr. Black, and that is the cost of the carbon electrodes, which is found to be a very considerable factor, and one that has been entirely overlooked.

Mr. Black: In reply to what Mr. Briethaupt said about regulating the pressure, and the Philadelphia engineers saying that they had to let the gas go to control it, I might say I have seen illustrations of a gas holder so arranged that as the gas goes up it shuts off the water; and as it is consumed and as the gas drops down it lets the water in, and by that means the manufacture of the gas is automatic. I think means will be found in practice to prevent the necessity of blowing off the gas when the pressure gets too strong. I noted here something about an error in figures, but I do not remember what it was.

The President: It was in reference to the laying of the pipes.

Mr. Black: Those two little words, "or no," had better be taken out; there must be some expense in laying the pipes. The cost of the carbide has been variously estimated; some have made it as high as \$100 a ton. Mr. Ferguson, who read a paper before the National Electric Light Association, figured it out, and I discovered an error in his figures of \$7—reducing his figures by \$7. I have not the paper with me. He was figuring on ten tons a day production, and he reduced the cost of labor, and so on. The price of the carbon electrodes he places at \$7.77 for each ton more than the lime and the coke. That should be reduced by one-tenth, making the cost per ton 77 cents. I included the cost of the carbons in the other charges. As to the poisonous nature of the gas, one of the authorities who experimented declared it was only one-seventh as poisonous as ordinary gas. I won't vouch for that, but that is his statement. He is a Frenchman, and claims to be a scientific man. I think I have covered all the points, as far as I know. Had the convention been a few weeks later I would have had more perfect apparatus. Mr. Willson offered to send me one of the smallest household arrangements that he was making, but it was not yet completed, so that I had to come away without it. I left this until the last moment, expecting to have a more complete outfit. In the course of a few weeks we will have it before the public, and then the exact price can be got at.

Mr. Briethaupt: In answer to what Mr. Black has said, I wish to call attention to the fact, not that the water could not be shut off, but that the gas does not stop generating the moment the water is shut off, because the calcium carbide has to absorb all the water that is in the jar before it stops generating, and in that way the danger arises from generating with a small plant. I said that in Philadelphia they did not have any arrangement to relieve the pressure. I have much pleasure in proposing a hearty vote of thanks to Mr. Black for the paper he has given us. I am sure that it has been of great interest to the Association and of great benefit.

Mr. J. J. Wright: I think it is only fair to give it due credit. I think Mr. Black states in his paper that it is intoxicating; that certainly is a point that ought to be in its favor. I would like to trouble Mr. Black with one more question; that is, where is that 200,000 horse-power in the Province of Quebec?

Mr. Black: In the backwoods somewhere.

The President: It has been moved by Mr. Briethaupt, seconded by Mr. Wright, that a hearty and sincere vote of thanks be tendered to Mr. Black for his care in the preparation of this paper. (Carried with applause.)

The President: Mr. Black, I have great pleasure in

conveying to you the thanks of this Association for the trouble and care you have taken in the preparation of this paper.

Mr. K. J. Dunstan: I may mention a little incident: A good many years ago we had trouble in Hamilton with a certain telephone line; we could not find the interruption. After a while a youngster was found hiding behind the fence tapping the line with a home-made telephone. Nothing much was done to the youngster, but the telephone was confiscated. The youngster was Mr. Willson.

Mr. Black: I think I have that telephone yet.

The President: Is it your wish to adjourn, or shall we proceed.

Mr. J. J. Wright: I move that the convention adjourn.

At 4:30 p.m. the convention adjourned to Thursday, June 18th, at 10 o'clock a.m.

ILLUSTRATED LECTURE BY MR. JAMES MILNE.

In the evening the Rotunda of the Board of Trade was filled with ladies and gentlemen assembled to hear Mr. James Milne's lecture on "Radiant Matter." The lecture was illustrated by numerous diagrams projected upon a screen, and with demonstrations of Roentgen rays, and was received with much interest and appreciation by the audience.

Immediately following the lecture a visit of inspection was made to the power stations of the Toronto Electric Light Co. and the Toronto Railway Co.

SECOND DAY.

MORNING SESSION.

The President called the convention to order at 10 a.m., and announced as the first order of business for the day the consideration of a place for the holding of the next convention.

Mr. J. Carroll: Mr. Chairman, I have pleasure in suggesting Niagara.

Mr. Briethaupt: I second that.

Mr. J. J. Wright: As I understand, there is no strong representation of the Association at Niagara Falls. That of course means that if we held a convention there we should have to carry our supplies along and make arrangements for the features of entertainment and so on independent of the place itself. I am not mentioning this because I have any objection whatever to Niagara Falls, but it is simply a matter that should be understood.

The President: That is a very important feature. We have no representative here from Niagara Falls. I presume when Mr. Carroll suggested Niagara he meant Niagara Falls.

Mr. Carroll: Yes.

Mr. Kammerer: While we have no representative at Niagara Falls except one, all that know that one will say he is a host in himself—that is, Mr. Ross Mackenzie. I think the social features, and the taking care of the people when they get there, can be safely left in Mr. Mackenzie's hands.

The President: Allow me to read a letter which was received some time ago in connection with the coming convention:

NIAGARA FALLS PARK & RIVER RAILWAY CO.,

MAY 13th, 1896.

A. B. SMITH, ESQ.,

G. N. W. Telephone Co., Toronto.

Dear Sir:—In connection with the coming convention of the Canadian Electrical Society, I beg to offer you on behalf of the company the freedom of the road for your members if you hold the convention at the Falls. We desire you to visit the Falls, and we trust that we may have the pleasure of your company.

Yours truly,

ROSS MACKENZIE, Manager.

We acknowledged the receipt of that letter and thanked Mr. Mackenzie very kindly for his invitation, and at the same time said that it was probable that at some future time we would hold our convention at Niagara Falls, and we would avail ourselves of his kindness. Are there any other places suggested?

Mr. J. J. Wright: It appears to me the only other place available would be Quebec. There was some

talk of that last year. There would be a certain amount of objection to that on account of its distance from this end of the country. Having held the meeting in Ottawa last year, it practically leaves us with Toronto and Montreal, and having held conventions in these places in the not very remote past, we are left almost without any choice but Niagara Falls. It is a fine place to spend a few days, and we should have a very pleasant convention there.

The President: It is desirable from the Association's standpoint that our conventions should not be held exclusively in one section of the country. Objection may be taken to having a convention held in Niagara Falls succeeding the one held in Toronto, but if there are no invitations to go anywhere else, we have no alternative but to accept and decide on Niagara Falls, and I presume it is decided that we go there. With reference to the time, I think it should be in the month of June.

Mr. Kammerer: I think that is about the right time. We have a good sample of June weather here and a good sample of the crop that June brings, and it would bring just as good a crop at Niagara Falls. There will be no politics at this time next year.

The President: It is for this convention to say whether they will meet in June or not. The Executive can fix the exact date. Is it your wish that the convention shall be held in the month of June? Carried unanimously.

The President: The next order of business will be the consideration of reports. We will take up Mr. Breithaupt's report of the Committee on Statistics.

Mr. Breithaupt: Mr. President, the report of the Committee on Statistics suggests the formation of something in the nature of a bureau of mutual information to be formed in the interests of the members of the Association, particularly to gather information regarding central stations, and keep it on file. The central station men throughout the country are particularly the ones whom we ought to get into our Association, and we thought that we could find no better way of interesting them than by framing some such scheme as this, whereby they would be benefited. I think the committee has done a little good work for the Association in increasing its membership. During the past year, I believe a number of central station men have come into the Association. With these blanks that we sent out we outlined our plan to the central station men and asked them to come into the Association. Some of them have done so. Now, as to the method of carrying out this plan we had in view: It would be a little difficult to carry it out unless we had the Secretary do the principal work of it, that is, keep the information on file and keep it properly tabulated, so that any member of the Association wanting information could write to the Secretary for it. Some might want information on the prices usually obtained for supplying power, or whatever it might be, and central station men are very reluctant to give this information. The schedule of prices, of course, they are not at all unwilling to give, because it is published and is public property everywhere, but any detail of matters as to prices, etc., they are reluctant to give, and naturally enough. It was thought a man might want information, for instance, as to prices, what prices were in other places. He could state his case as clearly as possible to the secretary, who would advise him from which members of the Association he would be most likely to get the particular information asked for. He would then correspond with these other central station men, and being members of the Association, mutually acquainted with each other, and knowing the object of the information sought, we thought the information would, in all cases, be cheerfully given. All central station men have had considerable experience in this. We received a great many blanks from central station men answering in a very reluctant or uncertain way, and saying we don't know what it is to be used for, nor where it is to be used; and in most cases they did not fill it out at all. We all recognize it to be information which is of value to us, because in town contracts, where we have to renew, the town authorities are always talking about that, this, and the other place where they get light for very

much less than we are supplying it; and generally they do not understand the details of the case, and simply say this corporation is getting light for less, and you have got to give it for that or we will get in another company to compete with you. If we could get the information in detail for such cases we would probably know why that corporation is getting cheaper light, and could then answer the authorities in that respect. I would like to hear the suggestions of the members on this point, particularly Mr. Hunt, who can give us considerable information along that line. This method is adopted in the National Electric Light Assn. He spoke to me about it yesterday, and there, I believe, they have derived very much benefit in that way.

The President called upon Mr. Hunt to speak, but he was absent from the room.

Mr. Kammerer: I think the scheme is an excellent one, for this reason: We have water power and we have steam power. In most cases where they have water power they sell the incandescent light more cheaply than where steam power is used, and if this information is secured in a statistical way, the central station man can talk to his customers and tell them that for that reason he cannot give them incandescent light at the same prices that a town plant 100 miles away can, because he has to produce it by steam. The consumer does not make it his business to find out whether the person is furnishing the light by using water or by using steam.

Mr. Armstrong: There is no doubt but that the scheme which Mr. Breithaupt suggests would be of great value to the industry generally. We are almost continuously in receipt of inquiries by companies renewing their contracts as to the prices paid and the conditions under which contracts are carried on throughout the country; and very often we are not in a position to give that information, because ordinarily we cannot get it on the same basis as the companies could directly, or as the Secretary of the Association could, in his official capacity. Referring to what Mr. Hunt stated to Mr. Breithaupt and myself last night as to the plan of the National Association, of which he is a member, he said that the Secretary, who was paid a proper remuneration for devoting a considerable portion of his time to the affairs of the Association, had, just in the way Mr. Breithaupt suggests, general information as to the conditions under which each of the central stations was carried on; and any member of the Association who was in difficulty of any kind, or wanted information as to the operation of his individual plant, could simply apply to the Secretary, and feel sure he would obtain the completest and best information, or a reference to central stations where he could get it, and at the same time feel it was the business of the Secretary of the Association to furnish him with that information. I think if any such scheme as this is carried on, that in the proper place we should consider the re-arrangement of the Secretary's position, so as to increase the remuneration to such an amount that the members of the Association would have no hesitancy in asking him for the information, and feel they had a right to expect it.

Mr. Kammerer: I fall in with all Mr. Armstrong has said, except the financial portion. If we are to remunerate our Secretary in a proper way for doing that work we would have to give him about \$1,200 a year.

Mr. Armstrong: My idea was simply this, that our Secretary now does a great deal of work free for the members of the Association, and it seems unfair to pile a great deal more on him.

The President: Our Secretary suggests that if we had the information a great deal of it might be available without much additional expense. It does seem desirable that we should have such a bureau through which information which is reliable and authentic could be easily and promptly obtained. It is of vital importance sometimes to the central station men to know just exactly what light is being produced for, and all the rest of it, in neighboring towns. I hardly think the Association is in shape in its present condition to undertake that work. The work done by the committee under Mr.

Breithaupt will bear fruit, and I think it would be wise for us to let the thing simmer for another year, and for the present go on as we have been going, and probably by that time it will assume a more definite shape, and we will then be in a position to do something.

Mr. Breithaupt: Mr. Mortimer and I discussed this matter some time ago. The committee on statistics for the coming year, whoever they may be, should, I think, be willing to do a great deal of the work, particularly in formulating the nature of the information that should be gotten together; and to carry on the correspondence for the Association would not be such a great undertaking, because the number of central station men in our Association is not so very large as to take up a great amount of time. If the Secretary and the committee on statistics would co-operate, it seems to me that something might be done during this coming year on this work, and it is certainly a work that we should undertake. We have got to do something to interest the central station men in our Association. If the Association is not to be of mutual benefit to its members, what is it for? I think if we add \$75 or \$100 to the Secretary's remuneration, which, it seems to me, we are able to do, Mr. Mortimer would be willing to attend to the correspondence part in connection with it, and with the help of the committee on statistics, I think the matter could be taken in hand now.

Mr. Mortimer: Mr. President, will you let me say just a few words on this point. As Mr. Breithaupt says, he and I have discussed this matter to some extent, and I feel that the Association might be of very much more use and practical value to its members, especially central station men, if we had such a bureau as is proposed. I agree with Mr. Breithaupt that we cannot commence that work any too soon, and so far as I am concerned I am quite willing to do my share of that work for the coming year without any extra remuneration, to see how the thing works. After that, if it is a success and you see fit to increase my remuneration, all right. I would like to see that thing started, and to see the Association do some practical work, and anything I can do will be gladly done.

The President: Our Secretary is offering his services out of the fullness of his heart. I think very few of the members here realize the enormous amount of work devolving upon him, which he has performed. The remuneration we speak of is simply for the actual expenditure and not of being a remuneration for his services.

Mr. Breithaupt: Mr. President, I would move the adoption of this report.

Mr. Yule: I second that.

The President put the motion, which on a vote being taken, was carried.

The President: It is necessary that we have standing committees for the next year, and I would nominate Mr. A. A. Dion, of Ottawa, and Mr. J. A. Kammerer, of Toronto, to bring in a report this afternoon. The committees are on Legislation and Statistics.

Mr. P. G. Gossler: Do I understand from the adoption of the report that the Committee on Statistics will undertake the extra work?

The President: The committee will be continued and the work with it. We will now proceed with the first paper on the list entitled, "Meters" by Mr. James Milne. (See page 149).

Mr. Milne, on rising to read his paper, was greeted with applause. He said: In getting up this paper on meters I thought first of devoting the whole of it to chemical meters, but as the number of central stations using the chemical meter is very small, I thought we might just throw in the rest, as it were.

Mr. Milne's paper was fully illustrated by diagrams thrown upon a screen by means of the stereopticon.

The President: Gentlemen, the paper is open for discussion.

Mr. Rosebrugh: I would like to ask Mr. Milne if there would be any conscientious objection on the part of the company if they substituted silver for zinc?

Mr. Milne: I don't see that there would be any objection at all. Probably the cost would be a little

more with the silver, but as long as the principle is the same, I don't see that there could be any objection.

Mr. Armstrong: Mr. Milne has certainly given us a very interesting paper. I think it must be a source of congratulation to Mr. Wright that he is able to meet such customers as Mr. Smith (referring to Fig. 8 in paper) when they kick about the mysterious results obtained from chemical meters, because he would certainly satisfy them that they must be wrong and the meter right. A very large part of Mr. Milne's paper loses its importance in view of the fact that the larger amount of current for incandescent lighting is supplied from alternating stations, and except the Lowrie Hall meter, which Mr. Milne did not go deeply into, and which is hampered by requiring a storage battery, there is no chemical meter that can measure alternating currents. In a place like Toronto, where direct currents are used, the chemical meter is all that is properly claimed for it, but I think Mr. Milne in his excessive zeal has gone somewhat beyond the general facts of the case in the claims for inaccuracy which he urges against the recording motor meter. The result of the Government Inspection tests which Mr. Higman, whom I see here, will no doubt be able to give us more fully, seems to show very good results indeed for the watt meters throughout the country. When you consider this, in view of the fact that many of them have been installed for several years, and not always under the best conditions, I think we have reason to consider the results as sufficiently accurate. There is one thing which I would point out in connection with Mr. Milne's awful example of a 500-light meter; such a building as that was used in would be a large office building in which a large number of the lights would be going continuously, sufficient at all times to run the meter. Mr. Milne goes on to state that the same conditions obtain through all the smaller sized meters, and I presume the same percentage for the number of lamps required to start the meter. There are in Toronto about 1,500 meters, and the number of lamps to be supplied from these would be about 35,000; that would make the average size a meter of 25 lamps capacity. If we allow Mr. Milne's claim that it takes twelve lamps to start the 500-light meter, that is only slightly over two per cent. of its current capacity. Taking the average as 25-light meters throughout the entire plant, the amount of current required would be slightly over half that required for the supply of one lamp, with the average sized meter. If Mr. Milne admits that, he admits that the meter perfectly fulfils its purpose, and that on the average it will start with less than the minimum possible load that can be put on it. There is a further objection in connection with the chemical meter for use in small stations which some stress should be placed on, and that is that the apparatus required for measuring the zincs is delicate and expensive in first cost, and in spite of Mr. Milne's assertion I do not think the ordinary lineman who is left to look after such matters would be capable of handling the delicate milligram scale used in connection with it. A good deal of the trouble which occurs in connection with recording meters, and I can speak more particularly of the Thomson meter, is on account of the careless manner in which they are installed. We had a case in point not very long ago. We shipped out a meter where they had not been using them before, and a complaint was received that it would not operate. We wrote enclosing a copy of the instruction book and saying that the plugs which held up the armature from the jewels should be taken out. They replied that they had not been taken out, and thanked us for the information. We heard later that the meter still failed to operate, and the complaints made about it were very severe, but upon investigation we found that the local expert had taken the meter up to the garret of the house and laid it down on its back. A Thomson recording watt meter won't operate that way. Leaving aside those failures to operate, which are the result of carelessness in installation, I think we may claim a very satisfactory general operation for the Thomson recording meters which are on the market. I do not mean to say that in large central stations using

direct current, where the admittedly superior accuracy of the chemical meter can be obtained economically, that the recording meter should invariably be used, but for the general run of stations, we are obliged to put up with the recording meters, even though they are open to some of the objections that Mr. Milne states.

Mr. Thomson: How many stations in Canada are using this meter?

Mr. Milne: Three; Winnipeg, London and Toronto, I think. I would suggest in answer to what Mr. Armstrong says that it is not the general custom of the linemen to read meters in any central station of any importance. A man is generally detailed for that sort of work alone, and I think that any station that hires a lineman—that is, a man that goes around putting up wires and the like of that—deserves to have poor results from their meters. As Mr. Armstrong illustrated in the case of the man who laid the meter on its back, it means, of course, that to a certain degree, the results obtained from the recording watt meters are caused by carelessness. I might say that I think we have in Toronto the best men procurable for the meter business, and even with meters adjusted to almost perfection we have got some percentage of error right through; no matter what size, whether it be a 500-light meter down to a 5-light meter, we have the same percentage of error right down. We cannot ascertain whether the meter is registering correctly unless we put something in series with it to find out. I know by a large number of trials that when we put in the chemical meter the watt meter was slow in every particular instance. With reference to the taking out of the jewel, this cannot be done now unless the meter is taken down to the inspectors, so that they may see the seal broken. Everything is fixed up in first-class order before the meters are taken from the electrical inspector's office. I do not see that anything can be said on that point at all. In fact, we see that the meters are in the best possible shape before they are sent to the inspectors.

Mr. G. Black: I did not expect to take part in this discussion. I have a constant recording watt meter in Hamilton which represents the perfection of meters. I can certainly testify that it does record. I will say that it goes night and day, whether there is any current on or not, judging from the results. We have about 20 lights in my office, and I was told that they were 60-watt lamps. For a long time, taking the length of time these lights were burning, and counting for 60 watts per lamp, according to the record, I found that the meter seemed to read about 25 per cent. ahead of any calculation I could make.

Mr. Armstrong: Perhaps the lamps were not of the efficiency they were supposed to be.

Mr. Black: If I allowed about 100 watts per lamp it would agree with the meter's record. I think on any one lamp it will be sure to run. We had it inspected by the government inspector lately and sealed up, and the man who brought it back told me the inspector said it was all right, so I let the thing go and have not looked at it since. I would like to sell it to any electrical company to run up their dividends.

Mr. Wright: As against all these fine theories as to the watt meter we have the ghastly results of experience, and we cannot go behind the returns. Mr. Black has given us a case in Hamilton; I will give you another. In the city hall the company were running some lights in one of the departments. After a little trouble we persuaded the authorities to adopt the electric light throughout the entire city hall, and that necessitated a change in meters. The lights were used in the police station previously, and the proposition was to use them in the entire city hall. A change was made in the meters and the current was turned on in the entire city hall, but to the surprise of the company their bills were smaller than they were before all the city hall was illuminated. It depends on the meter being made of a size to accommodate the whole of the building. The lights used in the police station were six in number and were used during the 24 hours, under the previous circumstances, and the company got paid for it. When the larger

meters were put in, the council, of course, meeting once a fortnight, when the six lights only were turned on, they did not register a scrap.

Mr. Armstrong: I think, as a matter of fact, a complaint of that character, so extraordinary and beyond the usual, would require the attention of the government inspector. I think that is an exception, and the meter must have had something wrong with it.

Mr. Wright: The meter was inspected by the government inspector. It was carried there as carefully as it could be carried; it was installed with a spirit level; it was not set on its back or put upon its face, and all precautions were taken, and that is the result. It is very plain to see the reason, as Mr. Milne has stated in his paper. And that state of affairs occurs to a greater or less degree in every installation. You take a delicate piece of mechanism like an electrical meter, box it up so that you can't see it or do anything with it, and expect that thing to run without any attention, and it is out of all reason. The utmost that I ever expected to get from the watt meter when the watt meter was first introduced, was an approximate idea of the current that the customer used, and I will defy any person who has had any experience to say that that is not so, that the utmost you can expect to get is an approximate estimate.

Mr. P. G. Gossler: In regard to the reliability of recording meters: since the law has been brought into action it has been necessary for us to go about changing all of our meters, and we have installed the Shallenberger meter. Since last July we have changed from about 900 to 1000. When they were installed each meter was inspected and the number of lights necessary to make them record was entered in the record book, and when they were brought in they were also checked off. While we have found some instances where the meters have become clogged through dirt or cobwebs, the results have been so satisfactory that we have no complaints to make. The question of allowing them to run without any attention, of course, cannot be considered. In a large installation it is necessary to read your meters. Of course we read our meters according to the customer: some monthly, some quarterly, but none over six months. The men who are employed in that capacity, and also checking out the bills, have become so thoroughly know what should be expected that in case of any falling off in the recording meter it is generally very readily noted. I have an instance that came to my attention on Monday. We installed for three months a government inspected meter; we knew that the man had installed fourteen lights and we had an idea of what his bill should be. Of course, it would only be an idea. His bill did not come up to what we expected and we immediately proceeded to investigate and make a test. Investigation of the meter showed that the light ran on whether the meter was recording or not. Still further investigation showed that there was a wire under one cleat short-circuiting the meter. We have found the reliability of those meters very satisfactory, especially during the last year, when we have had occasion to change and are changing all our other meters in the service.

Mr. Armstrong: I should like to ask Mr. Milne whether he intends in his paper to attribute this unreliability which he complains of to the Thomson recording meter alone.

Mr. Milne: The only meter that I know of so far in this country as recording watts is the Thomson watt meter; therefore the remarks, as far as I am personally concerned, apply to the watt meter. In all installations where the watt meters are used they must be of sufficient capacity to carry the maximum load with safety. Take for instance the Grand Trunk station. There are probably 1000 or 1500 lights there; we will say 800 to make sure. We had to put in a meter of sufficient size to carry that. During the day there are about from 10 to 25 lights used, and, as a positive fact, that meter certainly did not record on fifteen lights.

Mr. Armstrong: What size was it?

Mr. Milne: It was 160 amperes: I think that is the size of it. When we put in the Edison meter we found

exactly where the trouble was. I knew for a positive fact they were using light every day in their engineering, although we could not get any record on the meter. All we could do was to put on the chemical meter to find out. There was no negligence or carelessness in the installation of the meter. It was put up dead level and according to the instructions sent out by the company where it says, "Don't suppose you know it all." We take it for granted that we do not know all about it and simply follow the instructions sent out by the company, and in doing so that is the result we get.

Mr. Armstrong: Of course, Mr. Milne in the Grand Trunk case gives an instance of a very large meter, and the number of lights on which it fails to start is less than $2\frac{1}{2}$ per cent. of its total capacity. I presume Mr. Milne in speaking particularly of the watt meter is speaking of it from his own experience in Toronto. It being the only meter in commercial use for recording direct currents, it is the only one that could be used in connection with their three-wire circuits. I know it is not in accordance with the facts, or the result of the Government inspection of meters generally in Canada, that the watt meter has shown itself to be in any way less reliable in giving accurate returns than the other simple recording ampere meters; in fact, the results have been precisely the contrary. I should like to ask Mr. Hunt's experience with the watt meter; he has a great number of them installed.

Mr. Hunt: We have about 400 of the Thomson watt meters in use. I think they have all been in use for an average of eighteen months, some of them over two years, and about ten per cent. will run slow, and I think we have only one out of the lot that has run fast.

Mr. Milne: May I ask Mr. Hunt how he determines that amount? We would have something definite to go on. We have the chemical meter to prove that the watt meter is out that amount. How does Mr. Hunt determine it was out about ten per cent.?

Mr. Hunt: By the Government inspection, that is all.

Mr. Dion: I think that the cases stated by Mr. Milne and Mr. Wright are rather the exception than the rule. I do not think there is any mechanical device, no matter how accurate, against which such cases could not be brought up. If we go around the country looking for cases of failure, we are sure to find some, but I do not think they are the rule. We have in our city some 3,000 meters, I suppose two-thirds of which are Shallenberger, and the other third watt-meters. We have lately had occasion to have a very large number of these inspected by the Government. We test them at our office first and send them up to the Government afterwards. In many cases we find that those meters which have been in use from a few months up to five or six years are turning out very satisfactory. I don't suppose there are any more than from three to four per cent. that have to be touched at all before sending them for inspection. I think fully 95 per cent. register within the percentage allowed by the Act. We do not send them up until they are correct, because we do not want to pay the fees twice. With regard to the two meters, in answer to what Mr. Armstrong has said, I may say that while there has not been a very great difference, in our experience, between the two meters, in testing them, the difference has been rather against the watt-meter. The percentage of meters requiring fixing up before being tested by the Government was larger in the case of the watt-meter. The meter had to be fixed up, because it either didn't start with one lamp or went too slow. Leaving out this question of the relative merits of the meters, I would like to say a word in praise of the paper we have just heard. Its value lies in the fact that it keeps before us the defects of the apparatus which we use every day, rather than the qualities of them. I think it is only by keeping the defects constantly before us that we may expect improvements to be made. I also think that Mr. Milne is very wise when he advises that all currents should be used through a meter. I think that should be the universal practice, and should be encour-

aged by all possible means. When all the current is used through a meter you will find that it is a considerable relief to the central station. Our experience in that way is very satisfactory. We urge the meter in all cases, with the result that a very large per cent. of our business is done through meters. We find that with an installation of 54,000 lamps our largest loads have not yet exceeded the equivalent of 22,000 lamps; that is, the actual ampere meter readings, and it includes all losses from leakage in transformers, so you see the importance of using meters throughout the installation. As regards flat rates: There are some cases where it is absolutely necessary to make a flat rate, and in these cases the maximum use is the thing we want to get at; and if there could be such an apparatus devised as Mr. Milne has described as recording the time during which the lights are being used—if that could be so improved as to give the maximum load as well, it would be a very valuable adjunct in the case of flat rates. We could then make a rate very intelligently, which would be almost as good as a meter rate.

Mr. Wright: I would like it thoroughly understood, of course, that what remarks I have made in regard to these meters are not intended to apply to any particular brand of meter. For instance, the Thomson recording watt meter, considered in the abstract, is a most ingenious piece of mechanism. My remarks apply to all meters of the same description which depend on jewel centres and absolute accuracy of installation for their perfect working. We are compelled to take these meters. In one respect I may say perhaps our experience in Toronto differs very greatly from places like London and Ottawa, where watt meters are used almost exclusively in lighting systems where there are a comparatively small number of lamps. But you take the case of an installation in Toronto for motors and for elevators, where a sudden load is sometimes thrown on the meter in starting an elevator or a large motor, more than it is capable of bearing and more than it can be expected to bear, it happens in very many cases, in fact, in nine cases out of ten, the resistance will be burned out. What can you do? The meter is sealed up. You cannot get at it. You replace the burned-out part, take it to the inspector's office again, and the fee is \$2. And so it goes. My remarks in regard to these meters do not apply to the Shallenberger meter or to any other alternating meter without a commutator and without any trouble arising in the armature. There is no doubt that if we could confine ourselves to a meter of that description I do not think anybody would object. When we are compelled to put in a meter that we know will under extraordinary strains give us trouble, then the "coercion" comes in. If the Government would provide us with a meter that would work, and that would not be sealed up, I say it is perfectly right for them to inspect them, for the sake of protecting the poor consumer, but they should not compel us to lock up a machine that is going to be unreliable and that we cannot attend to.

Mr. P. G. Gossler: We had some Thomson recording watt meters installed, and we found it necessary to remove them because we could not record the loads. That applies only to loads varying very greatly.

Mr. Thomson: We placed recording watt meters on the motor circuits, and inside of a year's time we found about half of them burned out, so we discontinued the use of meters on all of them.

Mr. Wright: We have been obliged to resort to a flat rate, to our loss, and rather than instal a watt meter under certain conditions we have been driven to the use of the Pattee recorder. I am not blaming the watt meter, but simply because we cannot get a meter that can be sealed up which we can depend on to give us reliable and accurate data to charge up. We size it up in our imagination. We never salt a man any more than we think he can stand. We put in one of these lamp-hour recorders and magnets to suit, and he is chopping his wood and doing all that sort of thing by the hour. We find in a measurable degree it answers the purpose.

It certainly answers the purpose better than a Government inspected meter.

Mr. Milne: The Thomson meter is the most ingenious meter we have in the market to-day, but it is not applicable for our purposes here in Toronto.

Mr. Higman: I have just had this paper placed in my hands. After luncheon I suppose we will be able to take it up, and I will have something to say.

The President: I think the opinion of the members present is that we ought to adjourn this discussion. It is probably one of the best discussions we have ever had in a convention, and it does seem a pity to end it here, more especially as Mr. Higman is here and we would like to hear from the Government Inland Revenue Department. Is it your wish that the convention stand adjourned until two o'clock?

Mr. Dion: The point which has been raised by the paper just discussed is whether the Government was justified in shutting out the electrolytic meter, which is admittedly the most correct meter. This point can be very well discussed under the item on the programme, "Consideration of the Government Inspection Act."

Mr. Higman: I think the whole subject had better be discussed on this paper.

Mr. Armstrong: I have very much pleasure in moving a hearty vote of thanks to Mr. Milne for the very able paper he has given us. I believe that the discussion took a turn that was not expected, and which resulted in bringing out points that will be of interest and benefit. I do not agree altogether with Mr. Dion as to the desirability of the general use of the meter throughout the country. I think in connection with many of the small installations the certainty of their securing a revenue throughout the year, especially where they are operating by water power, is more desirable. I have pleasure, gentlemen, in moving a vote of thanks to Mr. Milne.

Mr. Kammerer: I second the motion.

The President: It has been moved by Mr. Armstrong, seconded by Mr. Kammerer, that a hearty vote of thanks be tendered to Mr. Milne for his valuable paper, which I am sure will be carried unanimously. (Carried.)

The President stated that a photograph of the members of the Convention would be taken at Lorne Park in the evening.

Convention adjourned until 2 o'clock, p.m.

AFTERNOON SESSION.

The Convention was called to order at 2 o'clock, p.m.

The President: I will be glad to receive a report from the Committee on Nominations for the Standing Committees for the year, legislation and statistics.

Mr. Dion: I beg to report as follows: Legislation Committee—Messrs. J. J. Wright, K. J. Dunstan, Berkeley Powell, L. B. Macfarlane, and F. H. Badger. Statistical Committee—Messrs. E. Carl Breithaupt, John Yule, and O. Higman. I may say these are the same as last year; they have done so well we thought we would keep them in office.

The President: It is hardly necessary to read the names again. Is it your pleasure that these gentlemen should form the committees on legislation and statistics to carry on the work for the coming year that was carried on last year?

Mr. Breithaupt: I have been on the Committee on Statistics for two years, and have given it considerable energy and thought. I have carried it about as far as I can. Somebody else may have different ideas from what I have, and would be able to carry it further. As far as I am concerned I think some one else might be put in my place.

Mr. Higman: I have been two years on it, Mr. President, and while I cannot say that I have given as much energy as Mr. Breithaupt has to the work, still I would rather have somebody else in my place.

Mr. Armstrong: The reason which these gentlemen give for retiring is the very reason why they should stay on. They are the only people in possession of the necessary information as to the method of procedure.

The President: I hope Messrs. Breithaupt and Higman will withdraw their wish to resign. The work

they have in hand is advancing very nicely, and it requires but a little more to put everything in very good shape. I think the Association would appreciate their efforts if they would continue. I suppose silence gives consent, and we will consider these gentlemen as elected to these committees.

The President: The next order of business will be nominations for President.

Mr. Kammerer: I have much pleasure in nominating Mr. John Yule, one of the initial members of the Canadian Electrical Association, as our next President.

Mr. Milne: I beg leave to nominate Mr. E. C. Breithaupt as President.

Mr. Breithaupt: I very much thank my mover for mentioning my name for the honorable position of the Presidency, but I think Mr. Yule deserves this honor more than I do. He is one of the charter members of the Association. I beg, therefore, to withdraw my name in favor of Mr. Yule. (Applause.)

Mr. Yule being the only nominee for the position of President, he was elected to the office by acclamation, amid applause.

The President: I am sure it is a matter of congratulation to me personally that Mr. Yule will succeed me in office, and I have much pleasure in announcing Mr. Yule's election.

Mr. Yule: I beg to thank you for the compliment you have paid me in electing me to the office. I did not wish to accept the office, but it seems the general wish that I should do so, and in doing so I would ask the members to give me the same support as they have given to the other Presidents. The election of Presidents has generally been heretofore from amongst members residing in the central constituency. The office has formerly been in Toronto, and the work has been carried on very efficiently in that way. I do not know how it will work with a President residing at a distance. A great deal of the work will fall on Mr. Mortimer, and I will have to look to him to keep me straight. I would also ask the members here to elect a very fair contingent of the Executive Committee from the members residing in the city of Toronto; it has worked very successfully before.

The President: The next nomination will be for Vice-President.

Mr. Dion: I beg to nominate Mr. L. B. Macfarlane, of Montreal, as Vice-President.

The President: I may say, in all fairness to Mr. Macfarlane, that I had a letter from him this morning, in which he regrets his inability to be present, and regrets still more his inability to attend any of the meetings during the past year, and asking that as a personal favor his name be dropped. I do not think we ought to take any notice of that letter at all.

Mr. Carroll: Not at all.

The President: He is too valuable to be dropped out.

Mr. Wright: Mr. Macfarlane has been one of the useful members of the Association. He has always taken a great deal of interest in it, and until the present time has been present at every Convention. I should like very much to see Mr. Macfarlane's nomination made unanimous.

Mr. Macfarlane was then declared elected to the office of first Vice-President of the Association by acclamation.

Mr. J. J. Wright: I beg leave to nominate Mr. E. Carl Breithaupt for the office of second Vice-President.

There being no other nominations Mr. Breithaupt was elected unanimously to the office.

The President: The next officer to be elected, and one of the most important, is that of Secretary-Treasurer.

Mr. Carroll: Oh, that is settled.

Mr. Breithaupt: The Secretary-Treasurer that we have had for a number of years past, in fact since the formation of the Association, has done very much in the work of carrying on the Association, keeping it on its feet, and making it what it ought to be. I feel we would be doing a great wrong in not keeping him. I therefore move that Mr. Mortimer be elected by acclamation as Secretary-Treasurer for the coming year.

Mr. Mortimer was then elected by acclamation to the office of Secretary-Treasurer.

Mr. Mortimer: I thank you, gentlemen, for this, the fifth or sixth time, of the very kind expression of your favor.

The President: The next thing is the election of the Executive Committee. It is desirable for many reasons that there be a continuity in the membership of the Executive, and for that reason five of the ten must be selected from the present list. The five who in your estimation deserve consideration at your hands, are to be marked, and the remaining five will be nominated and elected afterward. Our constitution says that the method of procedure in this case would be that the Secretary shall read the names, and the person, as his name is read, shall rise and deposit his ballot. This of necessity would prolong the Convention, and as active members only are allowed to vote, and to shorten the proceedings, I would appeal to the honor of those who are here that no one shall vote who is not entitled to, and the ballots will be distributed and collected. Before doing that it is necessary to appoint two scrutineers, and I would nominate Mr. Geo. Black and Mr. Geo. White-Fraser to act as scrutineers.

Mr. Breithaupt: At the Convention last year I thought that it was decided that the members of the Executive Committee were to be elected for two years?

Mr. Carroll: That was the intention of the by-law, but it was changed.

Mr. Breithaupt: How is it now?

Mr. Carroll: They have got to be re-elected every year.

Mr. Wickens: Yes, but five members of the old board have to be re-elected.

The President: As Mr. Breithaupt has been elected to the office of Vice-President, he will not now be eligible for election on the Executive.

Mr. Wickens: While the ballots are being collected, I move that \$50 be appropriated for the use of the Secretary-Treasurer to meet the expenses in connection with the work of the Association.

Mr. Kammerer: I second the motion.

Mr. J. W. Taylor: I do not know that that sum is sufficient.

Mr. Breithaupt: The sum that has been set apart heretofore has been \$50.

The President: It was formerly \$25, but last year at Ottawa it was made \$50, and we propose this year that it should be the same.

Mr. Breithaupt: The Secretary-Treasurer has more work to do, and I would move that the sum be made \$75 instead of \$50.

Mr. Higman: I moved at Ottawa last year that the sum should be made \$75.

Mr. Wickens: Under all the circumstances I will withdraw the original motion and Mr. Breithaupt's amendment can be put as the main motion.

The President: As far as money is concerned, I am quite satisfied that money could not pay Mr. Mortimer for all he has done for this Association, and I shall be delighted, personally, to have the sum made \$75.

The President: It is moved by Mr. Breithaupt, seconded by Mr. Taylor, that the sum be made \$75. Is that your wish?—Carried.

Mr. Mortimer: I may just say in regard to this question of remuneration that I do not want to see this Association bankrupt, and I think if you go on putting up the Secretary's salary every year it is going to bankrupt the institution. I think we had better let the salary stand as it was, and if we find at the end of next year that there is anything left out of that "\$29,000 surplus," I will take what is offered.

Mr. Wickens: I don't agree with that at all; I think the association is good enough to make up the difference.

The President: The following members are elected to the Executive in the order in which I read them: Messrs. J. J. Wright, A. M. Wickens, K. J. Dunstan and J. A. Kammerer, and for the fifth position there is a tie. On the casting of ballots by two members who had been absent from the room, the position of fifth member of the Executive was accorded to Mr. Geo. Black, of Hamilton. The nominations for the remaining

five members of the Executive were then proceeded with.

Mr. Breithaupt: I have much pleasure in nominating Mr. Hunt, of London.

Mr. Wickens: I nominate Mr. F. C. Armstrong, Toronto.

Mr. J. J. Wright: I nominate Mr. A. B. Smith, Toronto.

Mr. Kammerer: In view of the fact that we have decided to go to Niagara Falls, I have much pleasure in presenting the name of Mr. Ross Mackenzie.

Mr. A. A. Dion: I beg to nominate Mr. J. W. Taylor, of Ottawa.

Mr. Carroll: I nominate Mr. Dion, of Ottawa.

Mr. Armstrong: I have much pleasure in nominating Mr. John Carroll, of Montreal.

Mr. W. A. Johnson: I beg to nominate Mr. Milne, of Toronto.

Mr. J. J. Wright: I nominate Mr. W. A. Johnson, of Toronto.

Mr. Carroll: I beg to propose Mr. E. C. Cary, of St. Catharines.

Mr. Armstrong: I beg to nominate Mr. W. Williams, of Sarnia.

The President: While the scrutineers are doing their work in this connection I think we might go on with our proceedings. The first thing to be considered is "The Government Inspection Act." If anybody here is prepared to say anything the meeting is open for that purpose.

Mr. Higman: With reference to the paper that was read by Mr. Milne this morning, I notice that while it contains nothing very new, yet the facts are arranged very satisfactorily, and the deductions that he has arrived at are most convincing, viewed from the standpoint of Mr. Milne and those who employ him. Running through the whole paper, and underlying almost every paragraph, we detect the fine work of the special pleader. From beginning to end it is a plea for the electrolytic meter, and from that standpoint I think Mr. Milne has succeeded very well and has earned the thanks of his employers. He says the electrolytic meter has been condemned. He might have added that it has been very generally condemned both in England and the United States for every-day practical use. He says consumers do not want to keep a record, an exact record, I think he says, of the supply. They do want to know, however, to what extent they are using the current; they want to be able to determine from time to time what the rate of consumption is. I think that is very reasonable, and it is not surprising that they should ask for a direct recording meter. In regard to that very question we have received at the Department dozens of letters complaining bitterly about the use of this meter. We have received several such letters from Toronto and Kingston, asking that the Department put a stop to their use at once, instead of allowing them to run almost indefinitely. And while Mr. Milne designates the idea, in regard to renewals, as renewing the whole meter, as "gross rot," anyone who knows anything about it will agree with the proposition that to renew the plates is to practically renew the meter. Mr. Milne makes some complaints as to the unit of current. May I ask if there is anything wrong with the method of determination as laid down in the Act?

Mr. Milne: The definition is perfectly right, and the method of arriving at it is correct.

Mr. Higman: A paragraph in Mr. Milne's paper says "The Government has to raise a revenue, that is settled. The gas companies contribute a certain percentage of that revenue; the electric companies are their greatest competitors, therefore we can readily infer that any little obstacle that can be put in the way by such companies will be done so, and it is very common property that this Act was the result of the gas companies." I deny that, as far as I have any knowledge of the papers. I have seen all the papers that have been sent to the Department in connection with this subject, and I have failed yet to discover a single word or line from any gas company asking for an Act of this kind. Mr. Milne's statement is not borne out

by the facts. I might say in connection with the question of fees that in Canada there are thirty-seven gas companies, and from these thirty-seven companies we collect a revenue of some \$14,000 to \$15,000. At present there are two hundred electric light companies registered under the Registration Act, and from them we expect to collect about \$4,000 a year. During this year we shall have more than that, because of the order that was passed, asking that all meters be verified before the 1st of July, but after this year we shall not collect more than about \$4,000 or \$5,000 a year from the whole country, taking in about two hundred and fifty companies; so that as compared with gas companies the latter not only pay a certain percentage, but nearly the whole thing. Mr. Milne asks among other questions, "Are there any advantages to be derived from this test?" and answers it in the affirmative. I would like to ask Mr. Milne if that is his opinion to-day? Whether he is in favour of having the inspection? I will pause for a moment to get his reply.

Mr. Milne: The answer to that, as far as I know, is in the affirmative yet; the inspectors are benefited. I don't see that it benefits any one else.

Mr. Higman: It is not a very fat thing for the inspectors. Up to the present time, although their work is nearly double, they have not received a cent additional remuneration. Notwithstanding what the inspector derives from it, I am inclined to think that Mr. Milne would not refuse the job himself.

Mr. Milne: No, sir. In fact, I applied for one of just the same kind.

Mr. Higman: Now, a word or two in reference to the difficulty mentioned by Mr. Wright. I admit it is a real difficulty and one that has engaged the serious consideration of the Department. Some time ago I suggested to Mr. Nicholls that perhaps the difficulty could be overcome by hinging the bevelled piece of the case immediately below the dial plate. This opening could be sealed by the company. It would enable them to get at the commutator to clean it at any time, and such opening would not affect the registration in the slightest.

Mr. Wright: That would work all right if the Government would be content. Speaking for the company that I represent, I don't think the company would order any subordinates to go around and spin the meters ahead at all.

Mr. Milne: I did not mean that. I don't think the Government would have any objection to that, because the consumer has it in his own hands. He is always there when the company's representative goes around, and there could be no objection at all to having this opening in the meter to clean it. I would suggest that in matters of this kind the association should appoint a committee, and if there are any grievances to be remedied or considered, to wait on the officers of the Department and see if some means cannot be found of overcoming them.

Mr. Milne: Mr. Higman says he has received several complaints from Toronto regarding the chemical meter. It is astonishing that we did not hear of them, when we have so very few complaints here. I would just like to ask you are the parties using the chemical meter here in Toronto who have been doing the complaining. I think you will find that it is a customer who does not wish to pay for what he is using. No company, I am sure, will charge for more than what is honestly burned, but they certainly wish to get paid for what goes through the meter. Mr. Higman is of the opinion that renewing the plates in the chemical meter is practically renewing the meter. If we had to supply five pointers for a recording meter, is that supplying a new meter? The meter itself is composed of a German silver shunt; in multiple with this shunt is placed a compensating spool; in series with this spool is placed an electrolytic cell in which is placed two plates. The two plates are a very small arrangement as compared with the meter itself. I cannot see how renewing the plates in that meter is practically renewing the meter.

Mr. Higman: You cannot use a meter without the plates; it is the only part that needs renewing.

Mr. Milne: Mr. Higman speaks about the inspectors verifying the meters at the station. I think it would be a good idea for the inspectors to go to some of the stations and have their meters verified, because in the principal stations here in Canada the very best meters procurable are put in. It is not to the interests of the company to run below the voltage, nor it is not to their interests to run above the pressure; that would simply mean increased lamp renewals, and if they run below the light is poor. If we run above pressure that is a loss to the company, and not to the customer.

Mr. Higman: Certainly. That was my contention. We want to save the company any loss.

Mr. Milne: I think the companies will look after that in good style. In the letter which Mr. Higman wrote to the ELECTRICAL NEWS last month he says one of the inspectors called at a station, and found that the meter was four volts out. A station of that kind deserves to be soaked just for as much as the law can give in running instruments of that kind.

Mr. Wright: In the first place my objection is not to the Thomson watt meter as a meter, and I am not objecting to Government inspection as Government inspection. I must say this, and I am bound to say it in all fairness, that in all our communications with the Department and with the subordinates, we have been treated universally with great consideration, and the inspectors have acted in a gentlemanly way all through to the best of their ability. It is the combination of the two that makes the trouble; it is taking a meter that will not operate and locking it up in a glass case and expecting it to operate, and the Government Inspector coming along and saying that it has got to operate. It seems to me the suggestion of Mr. Higman is a good one, that some means of access to the delicate parts of the meter should be provided. If that is done it takes away a good deal of the force of the remarks that have been made. We have no objection to the Government seeing that the meters are right, but it is manifestly unfair to take a machine that requires attention, that should be opened and carefully cleaned, and the brushes and commutators attended to and put on the home stretch for another run. I say it is unfair when that meter is sealed and shut up and that cannot be done. If some method can be got at, and if the Government are willing to allow some means of access to the delicate part of this mechanism, that gets over the major part of the difficulty. I am speaking from what I find. It is a heart-breaking job when you have to handle the number of meters we have here in Toronto, and under the conditions in which we are expected to handle them; in fact, it is enough to make a man give up in despair. The meter is sealed up, and is supposed to be right. It possibly gets a little jar in being taken to the place of use, or getting it up on the side of the wall, and it does not read correctly, and there is no way, according to law, of having that remedied. They are entitled to charge a new fee for inspecting it again if we take it back. If some method could be adopted by the Government inspectors so that when a meter is brought to them, after it has been in use for a short time, it could be reverified without expense to the company, I think it would be well. Some of these meters, if we did not take them out, would be an eternal source of expense; it would be pay, all the time, to have the meters verified. Let me say just one word about the letters Mr. Higman has received. I have no doubt he has received them, because I have received similar ones, and it is altogether likely the parties in sending them to me have communicated with Mr. Higman; they probably would have written also to Queen Victoria and Lord Salisbury; but when the Government has got a clause in their Act which says that every man is entitled to a direct reading meter if he demands it, what is the kick about?

Mr. Higman: I don't know. It is Mr. Milne that is kicking.

Mr. Wright: When a man has an objection to a chemical meter, and says I want something I can read myself, we meet him, so that the force of these complaints is lost. I just want to make my position plain

in this matter. It is not a question of finding any fault with any particular brand of meter. It is very far from my intention to criticize the action of the Government or the officials. We have always been treated as an Association and as individuals with the utmost consideration by the Government officials, but it is the combination of the two where the difficulty arises. If the Government will adopt the method Mr. Higman suggests I will have no doubt that will overcome a good deal of the difficulty. I move that the Legislative Committee of the Association take up the matter with the determination, if possible, to see if any mutual arrangement can be made to make the matter more satisfactory.

The President: When two parties are favorably disposed there is always a way of coming to an arrangement which can be made mutually advantageous. I know Mr. Higman has a difficult task to perform, and his inclination is to do justice to all concerned.

Mr. Higman: Before sitting down I would like to read a letter from one of our inspectors who thinks he has been rather unfairly treated, and he wishes to be set right before the Association. The letter is as follows:

O. HIGMAN, Esq., Ottawa.

"SIR: Your favor of yesterday has been received, asking if I know to whom a certain article in the ELECTRICAL NEWS refers. I have already received a copy of the NEWS with the article in. It may refer to me, but I must say I have not interfered directly or indirectly with the electrical plant or apparatus of any electrical work in Hamilton or elsewhere. What I have done is this: About a year ago I met on the train Mr. Robert Thompson, President of the Electric Light Company, and in course of conversation he spoke of the excessive amount of fuel they were using under their boilers. He said I must, when in the business, have had practical knowledge of this subject, and asked me what was the cause of using so much fuel. I suggested that possibly the chimney was too small for the services required of it, and that I had some books on the subject which I would be willing to lend him. He said that Mr. Knox was the mechanic of the board, and that he would send that gentleman to me. Mr. Knox called and I showed him the books. I directed him to the places giving the size of the chimneys needed for similar plants, and told him he might make the calculation for himself. He copied the figures, thanked me for the use of the books and went away. Both these conversations were sought. I did not volunteer any information, and had nothing to say except the suggestion that possibly the chimney was not of sufficient capacity, it having been built for a much smaller boiler. This was about ten months ago, and I have not since spoken to any of the directors nor to other persons on the subject. I have not at any time in the remotest way offered my criticism or advice in connection with electrical matters. It would be presumption on my part to do so. As a practical mechanic I offered the suggestion to friends seeking my advice.

I am, yours, etc.,

D. McPHEE.

Hamilton, Ont.

Mr. Wright: Isn't that the case of the cap fitting the man?

Mr. Higman: I may state that the letter is in reply to inquiries made from the Department to the inspector.

Mr. Johnson: I would move an amendment to the last resolution, that is, that the question of removing the bond from the chemical meter be taken up. If the Government can be induced to do so, that chemical meter has a use for direct-current work and for power work; it is something that is very handy to use and there is the possibility also that it may be desirable to have it in connection with alternating work.

Mr. Fraser: I want to refer to one individual case that I know of myself. The inspector, whose name I shall not mention in public, but I will give it to Mr. Higman if he desires, managed to and purposely left the impression in the mind of a man who was just putting in an electrical plant that it was necessary before accepting the plant that it should be passed upon by the Government inspector. The purchaser was an ignorant man and the inspector was ignorant, if not more ignorant than the purchaser, but the purchaser was a perfectly creditable man, and told me distinctly that this inspector had purposely left him under the impression that the Government inspector was placed as a kind of watchman over the manufacturing companies, and it was necessary for him to pass that plant before the purchaser would buy. These inspectors have got no standing in the profession, but they go about with the influ-

ence and the weight which is given to them by the Government appointment and use that in a very wrong way.

Mr. Higman: I must say I am surprised to hear the statement just made. I can hardly understand that one of the inspectors, knowing very little about electricity, and necessarily so, should even attempt to pass judgment on matters of this kind. The Act contains no provision for the inspection of electric plants; it deals only with the public supply and the apparatus through which the supply is determined, and on which the consumers' bills are based. Applications to the Department have been frequently made, however, for the services of an electrical engineer to report on one thing and another, simply, I presume, for the reason that such services would be rendered free of charge. In every such case I have referred the parties to practising electrical engineers outside the Government service.

Mr. Black: I had a conversation with Mr. McPhee the other day in reference to this matter, and he explained it to me as he has written to Mr. Higman. The advice was sought in such a way that he could not refrain from giving some kind of an answer. He did not give his answer as Government inspector or official, but in the light of his past experience as to steam feeders, for he had a large experience in the feeding of similar heating apparatus. There was one instance where there would have been a loss of a thousand dollars on the plant if he had not studied up the subject and found the fault lay with the chimney, and convinced the Government officials, who had reported against him, that the fault was with the chimney. He had works on the subject, and he simply suggested that there might be some trouble of that kind, and loaned his works to these parties. He had no thought of acting as a Government official at the time, and he certainly did not intend to pose as an electrical engineer. He would have been at this convention only he felt it would be better for him to remain away during this discussion.

The President: An amendment was moved by Mr. Johnson, seconded by Mr. Wickens, that the Committee on Legislation also consider in their correspondence with the Government and Government officials the reinstatement of the chemical meter, as being useful for power on other circuits.

Mr. Breithaupt: Would it not be well to make that a little more general and say the committee shall have power to meet and confer with the Government authorities on the matter of electrical inspection and on all matters concerning the same, so that they may be able to deal with any exigencies that might arise?

The President: I see no reason why it should not be carried out.

Mr. Higman: I would suggest that if the committee wait on the Government that they give their complaints, or whatever they want, in detail. It is no use taking up the bill and discussing the whole thing over again, because you arrive at nothing; but if there is anything of a special nature that you wish to have changed, or discussed with the Government, let it be specifically stated.

Mr. Wickens: This is within the province of our legislative committee, and if there is anything that we wish to have changed, I think it is for them to take up the matter. I am satisfied they will do what is right. It seems to me that the matter could be arranged so that it would be reasonably safe to the consumer and reasonably good for the producer. The object of having a law of this kind is to do some good by it, and the object of this Association is to help the members and help the people in connection with their interests to do what is right, and to succeed. I think the committee should be able to go into that matter with a free hand, and I think the Government should be able to meet them as representing practically the whole of the electrical people of the country. I think the Government should meet them, and I think they will.

Mr. Dunstan: As a member of the Legislative Committee, I think it is not a question that should be left in the hands of that committee. It is a technical question

in connection with electric light interests, and I think there should be a special committee appointed.

The President: Mr. Dunstan's point is well taken. That committee should, I think, be composed exclusively of electric light men interested in that actual work. I think it would be proper now that a committee of three or five be nominated to take the matter in hand.

Mr. Milne: Mr. President, I would just like it understood that I have no particular hatred for any mechanical recording device. I have a particular love for the Edison chemical meter. My paper was originally intended to be on the chemical meter, but I thought it might interest some of the members of this Association to know the principle on which some of the other meters were worked, and as far as we are concerned here in Toronto we have had the most friendly relations with the inspector. I think we can get along first-class with him, and we have no friction at all in any respect. I think Mr. Higman will admit that. It was just simply in connection with that restriction of the chemical meter that I got up this paper.

The President: The nominations for the remaining five of the Executive Committee are as follows, and they are elected in the order in which I read them—Messrs. Ross Mackenzie, Niagara Falls; A. B. Smith, Toronto; John Carroll, Montreal; Charles Hunt, London; and F. C. Armstrong, Toronto.

Mr. Breithaupt: I would suggest Mr. J. J. Wright, Toronto; Mr. P. G. Gossler, Montreal; Mr. A. A. Dion, Ottawa, as a committee to interview the Government.

Mr. Armstrong: I would suggest adding Mr. James Milne, who is probably more thoroughly conversant with the subject of meters than anybody else present.

Mr. Breithaupt: I thought the committee would want to be very small. Mr. Milne would certainly be a good man to have on the committee; I would like to see him there.

The President: I think Mr. Breithaupt would do good work on that committee; that would make five.

The President put the motion, which on a vote being taken, was carried.

The President: We will take up now the paper by Mr. Armstrong entitled "The Outlook for the Electric Railway." (See page 15.)

Mr. Armstrong's reading of the paper was followed with applause.

The President: You have heard this very valuable paper of Mr. Armstrong's; the subject is a live one and I would like to have some discussion.

Mr. Hunt: I have great pleasure in moving a vote of thanks to Mr. Armstrong in having prepared his valuable paper on electric railways.

Mr. Wyse: I second that.

The motion was carried.

Mr. Fraser: I think Mr. Armstrong has given us a fair account of the position of electric railways in Canada. In the last paragraph he mentions something in connection with long distance railways. I think it would be quite interesting to the Association to hear some of the facts in connection with the electric railway at present running in Lugardo, which is described in some of the technical journals recently. They do not use the rotary transformers in connection with their system, but it is actuated by the direct three-phase currents. As to the question of the track, that seems to have been successfully overcome. In fact, I believe there are a good many of the best electricians of the day who have arrived at a practical, if not an actual and commercial solution.

Mr. Hopkins: There is one question I would like to ask Mr. Armstrong. He spoke of the limit of the field—of the road radiating out. I would like to ask about what that limit of distance would be at present? He might also answer what would be the limiting grade that it would be safe to build a railway on so that in the winter time, when there was ice on the rails, the car could be kept in control and there would be no danger of it being locked and taking the people down. Then there is another question. I have understood that the

alternating current is out of the question now for running electric railways, that they cannot get motors that will start up quickly. One electrical engineer of very high standing and of long experience and very well posted in the theoretical part of the work, told me, some time ago, that that was out of the question.

Mr. Armstrong: Mr. President, I might speak of the matter of limiting grades first, which would allow of the operation, I presume, of both light freight and passenger service during the winter season. On a matter like that you can only speak really from experience. I might instance very forcibly in this connection the case of the Galt, Preston and Hespeler railway. There they handle, and did handle during last winter, their passenger service without any difficulty over grades of five, six and even seven per cent; they also handled a light electric locomotive freight service over the same grades without any difficulty at all. Even over the longest grade which they have, which rises from the town of Galt to the C.P.R. bridge, and which at places is as high as six and a half or seven per cent., they can haul a load of two freight cars. On the grade at Preston, at the end of the line, where the grade is about five per cent., they haul, ordinarily, one, and in some cases two, coal cars loaded to their full capacity up the grade. It seems that up to the point that we can keep a reasonably high voltage without excessive line loss that we can handle the freight, and unquestionably the passenger service over tracks laid generally on existing grades, with very slight cutting down.

Mr. Hopkins: Would it be necessary to have motors on every axle and brakes on every wheel?

Mr. Armstrong: I might go a little further into the freight locomotive question at Galt. The handling of passenger traffic is comparatively easy. The car used for freight purposes is mounted on a single truck and with two motors, one on each axle, of the G. E. 1200 type, wound with a four turn winding, and there has been no difficulty at all. When the car was first sent up it was found too light to carry two cars up the grade at Preston; the wheels would revolve and the cars run backwards. That was remedied by putting some three tons of pig iron on the floor. Since then they have had no difficulty, even in the winter. As to the question of the limit or range over which we may expect these radiating or radial lines to extend, it is a difficult question under present conditions, to give any definite limit. One can only examine existing cases and find out how far they can commercially operate with success.

Mr. Hopkins: I mean with one power house.

Mr. Armstrong: Taking the Hamilton, Grimsby & Beamsville road with one power house located, as it is in their case, in nearly the middle of the road, they have a limit of 18 or 20 miles; a transmission limit of 7 to 10 miles from the power house would be about the maximum with which economical results could be obtained without undue expenditure of copper. They do not handle any heavy freight; they just haul light cars behind their ordinary passenger cars. The Hamilton Radial Electric Railway Co. are now building a line from Hamilton to Burlington, and in their case the transmission limit will be eleven and a half miles from the power house. In that case they found it would be much more economical to invest money in copper to reach that distance than putting in polyphase apparatus. The cost of copper there is very considerable. The limiting distance would be ordinarily something under ten miles from the power house. In connection with the use of the alternating motor, I was pleased to find Mr. White Fraser draw attention to the road at Lugardo. I do not think there is any reason to doubt at all, that we will have in use in America a successful alternating railway motor which will give a reasonably high economy and in which the difficulties of control will be surmounted; and with the use of that motor our range of transmission will be increased and the limit to which radial lines can be extended will be very much greater than it is at present. I had the opportunity of seeing a car at Schenectady some time ago in which it was endeavored as far as possible to conform to the requirements of ordinary traffic; and while there were

certainly some difficulties which in detail would have to be surmounted, there did not seem any likelihood that its success for practical purposes would be very long delayed; at least, the engineers who are looking after the matter speak in the most favorable way of the results they are obtaining.

The Convention adjourned at 4.30 p.m., to meet again Friday morning at 10 o'clock.

THIRD DAY.

The President called the Convention to order at 10 o'clock.

The President: The first thing on the programme is the presentation of papers, the first being a paper by Mr. P. G. Gossler, of Montreal, entitled "Some Central Station Economies." (See page 15.)

Mr. Gossler, on rising to read his paper, said: It was stated in the minutes read the day before yesterday that I had been asked to present a paper on high potential underground systems. The present subject has been selected because I thought it would be of more general interest to the convention. I have been for several years connected with the operation of the subways of New York city, and have a collection of data which I shall be pleased to place at the disposal of anyone who is contemplating entering into underground work. I may say in regard to plates 4 and 5 that I regret those plates are not larger, because I am sure they will be appreciated by anyone who has made lamp tests. I have larger copies of these and will be glad to place them at the disposal of anyone who wishes them because they represent a very great deal of labor. The formula which I have included in this article here is one that has been found very useful.

The President: You have heard this paper read. The subject is now open for discussion. I know there are a number here who are anxious to ask questions. I hope the discussion will be full, but quick.

Mr. Breithaupt: Mr. President, the Association certainly ought to tender its thanks to Mr. Gossler for the excellent paper he has given us on Central Station Economies, in the reconstruction of an old central station. All of us who have had experience in central station working know that the central stations which were put in five, six or seven years ago are according to present methods very inefficient. Not only is this the case with some of the larger central stations of the older type, but true with the smaller stations; that is probably a reason why so many of our smaller stations throughout the country prove very unremunerative to the people who own them. The reconstruction of the central station, particularly the small central station I have had experience with a number of these—is a matter of considerable difficulty. You speak to the owners of plant; they know that the plant is not remunerative; they know that from actual experience. There are plenty in the country who have not made a dollar out of it. With the old apparatus they have increasing and very great induction loss, line losses and all that sort of thing. You tell them to put all this old apparatus on the scrap heap—that it is the best thing to do—and you will meet with great opposition. It is a hard thing to do, to reconstruct particularly a small plant, to bring it to a proper basis. Mr. Gossler's statements about the transformers are very interesting indeed and very instructive, and the lamp curves even more so. Plates 4 and 5 are, I think, of very great interest to all central station men. I would like to ask Mr. Gossler what efficiency of lamp is used in Montreal?

Mr. Gossler: The efficiency of the lamp, as I have stated, depends on local conditions; there are some places where we can use a less efficient lamp than others. The lamp we mostly use is a 50-volt lamp, with a current consumption of 1.03 amperes.

Mr. Breithaupt: The formula Mr. Gossler gives here is also very instructive and one I think that is not generally known, and which will be of great interest to central station men.

Mr. Armstrong: The plant referred to in Mr. Gossler's paper is, I presume, that of the Royal Electric Co.,

of Montreal. I should like to ask Mr. Gossler, in considering this reconstruction, what is his reason for adopting the belt-driven generator?

Mr. Gossler: Mr. President, in regard to the adoption of the belt-driven generators, I would say that there are conditions under which the direct-driven dynamos are, of course, desirable. In the present case we were confined to the utilization of the engines we had in our station, which it was impossible to use in that way, if it had been so desired.

Mr. Wright: As far as that question of the direct-driven generators are concerned, there are other plants than direct-driven being installed at the present time. As to the question of belt-driven generators at the present time, as Mr. Gossler speaks of it, there are many reasons for the procedure. The question was not addressed to me exactly, but it might be in order to give one or two of the reasons. In the first place, you have an engine; it must be of a reasonable sized unit; it would necessarily be confined to that particular class of service. As an incandescent lighting load is a load that is at its maximum for a very few minutes during the day, comparatively to the rest of the 24 hours, you condemn your engine that is driving that large sized unit to idleness for 23½ hours, practically. By using a belt-driven generator an engine can be made to drive two, three or more generators for supplying different classes of service. Most stations, of course, are using currents of varying quality and it becomes necessary in a large city to do so; and the same engine can be utilized for all purposes, to a certain extent. Again, a belt-driven generator, driven from the fly wheel of an engine direct, may be considered, for all practical purposes, as a direct-driven generator. You have the flexibility in the belt, which is an advantage; there is also the question of the size of unit. This difficulty has often been found in using a very large direct-driven unit on an engine: there is always liability to accident by reason of any little inequality there might be in the bearings, or in bringing the poles too closely together where alternating machines have been driven direct on the shafts. All these questions have to be taken into the calculation in installing plants, whether direct driven or belt driven. You also have the advantage of running the engine at a slow speed, which all engineers will agree it is better to do if possible. As a rule, where you have direct-driven generators they are placed on the ends of the engine shafts, and that complicates, to a considerable extent, the engine itself; it probably nearly doubles its cost; it renders necessary the introduction of bell cranks. An engine with a straight shaft and overhanging disc and crank pin is simpler and more reliable. There are a number of reasons that would affect the question, a few of them I have given. I think there are many more.

Mr. Armstrong: I entirely agree with Mr. Wright that circumstances govern altogether the desirability of using the direct-connected or belt-driven generators. In this case I was considering the specific example which Mr. Gossler had put before us, of the reconstruction of the station in Montreal in which were installed five 300 K.W. generators. But, of course, the governing circumstances of their using their present engines would be the main factor there.

Mr. Ashworth: I notice in one portion of Mr. Gossler's paper he states it is only in a densely populated city and in the more densely populated portions of that city, that it is practicable to use the secondary main system. From my own experience, and I think from the experience of a good many smaller station men, it is quite practicable to use secondary station distribution in much smaller places than Montreal, probably in places of two to three thousand inhabitants. I would like to ask Mr. Gossler if it is not economical to use secondary station distribution in smaller places.

Mr. Gossler: When I said smaller places, I had no reference to a large or a small city. My statement was intended to refer to where customers were bunched or scattered. With reference to the limitation of the secondary system as I have stated in my paper the

most economical side of the balance can be determined by such a method of reasoning as outlined in my paper.

Mr. Armstrong: There is another factor which I think should enter into that, and that is the generally higher efficiency of the larger transformer.

Mr. Gossler: That is included in the cost of maintenance of a transformer; in the cost of maintenance in a transformer the leakage current is included, consequently the higher "all-day efficiency" of a transformer the less the cost of maintenance the maintenance of a transformer really being the factor that would bear the greatest weight in determining the type of transformer to be used.

Mr. Milne: I would like to ask Mr. Gossler in regard to this: He says: "Apart from this increase in capacity, there is also the saving due to running a smaller engine for the day load, and the consequent saving in labor, oil, etc." When they shut down a smaller one and open up a larger one, does the saving of labor start at that point?

Mr. Gossler: That refers, not to a temporary decrease in one day of 135 amperes. If you decrease the station leakage load 135 amperes, it means a decrease in the load for every day of the year which will permit the operation of a smaller engine during the day, consequently decreasing the item of engineer's salary.

Mr. Milne: According to that, they have an engineer for each engine.

Mr. Gossler: In regard to having an engineer for each engine, the circumstances may be such that that is necessary. If the engines are large that may possibly be necessary; it depends on local conditions. It is not a general statement at all. The requirements of the services of engineers is entirely a local consideration.

Mr. Dion: I think Mr. Gossler has earned the thanks of this Association for the valuable paper which he has just read. It is a paper of very practical interest to central station men; a paper which I regret I did not get into my hands sooner. I did not see these papers until I got here, and since we got here there has been no time to read. I would have liked to have become more familiar with it, so as to be able to discuss it more intelligently. I think it is a paper that should be thoroughly discussed. However, I am not in a position to do it justice. There is one part of this paper I wish to refer to, where he speaks of the records made in order to calculate the changes necessary to improve the regulation of the line, &c. In order to obtain the required information he established a system of transformer maps, pole maps, etc. Last winter, through the courtesy of Mr. Gossler, this system was shown and explained to me, and I can assure you it is the most thorough system of keeping records that I have ever seen anywhere. I found it so good that I adopted some of the features in that system of keeping records, and had them carried out after I returned home. But I must say I did not adopt the system in its entirety. I found it unnecessarily complicated for a city like ours, however useful it may be in a larger place like Montreal. However, there are many valuable features in that system which I was very glad to learn and to put in practice afterwards. Reconstruction is a problem which confronts every central station manager. It is no doubt, as many of you know, a very difficult thing to tackle, and there is a question of how far you should go on with this reconstruction. It is difficult to convince a board of directors that it is going to be a paying thing to scrap the whole station apparatus; but in many cases I suppose it would be well to do that rather than carry on the reconstruction by degrees. We are doing some reconstruction, but it is being carried on gradually. We have not scrapped any large amount of apparatus at any one time, but I suppose before we get through there may be a considerable amount put by. There is this to be considered, that in making a change before you are compelled to do it, you may save some money in making exchanges of generators. We have been able to obtain a very considerable allowance for old apparatus; and I am satisfied that if we had waited for two or three years more we would not have obtained anything for them. That is a great

drawback, this reconstruction which becomes necessary in connection with electric lighting. A prominent banker in our city told me he found that to be the greatest obstacle in the way of electrical investments; that is, in the opinion of capitalists, an obstacle. Regarding transformers, our plan has been not to scrap transformers and buy a new outfit, but simply not to buy any more small transformers. Where required we put up large units, displacing a number of smaller ones which are useful to supply customers in the more scattered portions of the city; and in that way the more thickly populated part is supplied by large transformers and secondary mains; and we found that to be preferable in our case than scrapping transformers in a wholesale way. I have one word to say in reference to the over-running of lamps. I quite agree with Mr. Gossler that it is not a practice to be recommended. In our city we made that mistake. It was brought about by a keen competition between companies and a desire to have our lights better than the others, and we got into the habit of running our lamps over the normal voltage, consequently it was found afterwards very difficult to reduce that. We had got into difficulty, the lamp consumption had become very large, and we found it necessary to stop this practice. I had read that the same difficulty had been met in other cities by a gradual reduction of the voltage, say half a volt every night; but we did not care to do it in that way. I could foresee a lot of trouble. We preferred to re-model the circuits for better regulation, and drop the voltage in one night, changing the lamps on that circuit during the day. It takes a horse and wagon and several men to do it, and it costs a good deal, but we thought that was a better way of doing it than to gradually lessen the voltage and allow complaints to come in. I would like to ask Mr. Gossler—he has been asked a good many questions, but seems good-natured about it—as to the means taken to overcome the induction between lines. We have had some difficulty in that way and we have taken some means to overcome it, and I would like to know whether he has taken the same means.

Mr. Gossler: The means that were taken were very simple and very well known. The local conditions were somewhat peculiar: we had three very large engines and three principal routes. It was found, due to mutual induction, unless all the circuits on one pole line were run from one set of dynamos there was a decided fluctuation; unless we ran each pole line on a separate engine, we were not given credit for knowing much about lighting. To overcome this inductive effect, the feeders were re-arranged, by simply bringing opposite polarities as near each other as the pins on the cross arm would permit. When the lines had to be reconstructed it was found that one leg of the circuit was on one end of the cross arm, while the other leg of the same circuit was on the extreme end of the same cross arm, so that the worse inductive effect possible was obtained. We did not go to the trouble of crossing the circuits as is customary in long transmission, because we found that it was unnecessary. We reconstructed, first, one or two circuits, bringing the feeders close together so that the mutual induction due to the other circuits was practically the same on both legs. After one or two circuits had been reconstructed, we found it unnecessary to cross the circuits, but simply proceeded on the line of bringing the feeders close together, which has given perfectly satisfactory results. We have some twenty old incandescent circuits, all heavy, and we find we can run one or two, or any number we please, on the same pole line from different engines.

Mr. Dion: That was exactly the conditions prevailing in our city. The circuits had been hung on opposite ends of the cross-arms for the purpose, as stated by the line foreman, of making the lines less dangerous. He said they had only one side of each circuit to work at, at one time, and there was a space in the centre which protected them from the other side. The men set up the plea that we were going to make their work much more dangerous, but when I explained to them that, the circuits being sometimes bunched on one

no certainty, that two adjacent wires did not represent different terminals of one machine, they saw that they were just as secure after the change than before.

Mr. Wright: This reconstruction business is a very difficult matter, and there is a case in point that occurs to me where I think the difficulty will be emphasized. The electric light company in Hamilton are just about appointing a manager, and it would become the first duty of that manager to recommend the Board of Directors to throw out the whole plant. From what I know of the Hamilton Board of Directors, I think they are a great deal more likely to throw out the manager. It will become a question of scrapping the plant or scrapping with the manager. Mr. Gossler is so very well posted on these subjects that I think it is a first-class opportunity to pump him a little further and see if we cannot pump him dry. There are two important questions that come up not only in reconstruction, but also in construction: one is the frequency to use in the introduction of an alternating system and another is the voltage; those are questions that a little fuller information would be very acceptable on. Authorities differ on both questions. Whether it is better to adhere to the old style of sixteen thousand alternations or thereabouts or the more modern in the neighborhood of seven or eight, and if Mr. Gossler has any reasons and would go more fully into them for the change of voltage from one to two thousand, the information would certainly be very acceptable to us.

Mr. Gossler: In regard to the change of voltage from one to two thousand, we have drops on our circuits varying from one to ten per cent.; the regulation, of course, corresponds. Increasing the voltage to 2,000 volts will decrease the drop one quarter of what it is at present; there is no practical hindrance to the use of two thousand volts—it can be handled about as readily as one thousand—also modern transformers are made interchangeable, so they can be used on either one or two thousand volts. If you are going to increase the saving and improve the regulation by the adoption of the two thousand volts without any practical inconvenience, there seems to me every reason in the world why it should be done. It was decided in our case to use two thousand volts, principally for the purpose of getting better regulation with the present feeders; we do not anticipate any trouble. The two thousand volts is in operation in many places. There may possibly be a little difficulty with the lines that are now in contact with trees, as we now have some little difficulty in wet weather at the places with one thousand volts, and two thousand volts would be a little more troublesome, but these conditions will be changed at any rate. In regard to the question of frequency, that is a question that has to be decided by the local conditions. If the lighting is of paramount importance or the principal feature of the station, there is no question but that sixteen thousand alternations should be used. It is practicable to operate motors from sixteen thousand alternations as well as eight thousand. The leakage of the transformers does not decrease exactly inversely as the alternations, but approximately so, so that the leakage of transformers at eight thousand alternations is probably twice as much as sixteen thousand, and where the lighting load is the principal feature the sixteen thousand alternations is very desirable for this reason. If the plant is to be supplied by power from quite a distance, where it is necessary to transmit power from fifteen, twenty-five or thirty miles, induction comes in as a factor to be considered, and in most long transmission plants the lower alternations have been adopted. But, as I have said before, where lighting is the principal feature, there is no question about sixteen thousand alternations, especially as motors can be as readily used on sixteen thousand as on eight thousand, so that sixteen thousand alternations permits of serving light and power from the same generators.

Mr. Breithaupt: I have great pleasure in moving a hearty vote of thanks to Mr. Gossler for his very valuable paper.

Mr. Dion: I second that.

The President: It has been moved by Mr. Breithaupt, seconded by Mr. Dion, that the hearty thanks of this Association be tendered Mr. Gossler for his valuable paper. Is this your wish?

The motion was carried amid applause.

The President: I think the Association is to be congratulated upon the fact that we have men capable of giving us such a paper as Mr. Gossler has given us. The next thing on the list is the paper entitled "Power Transmission by Polyphase E.M.F.'s," by Mr. George White-Fraser. (See page 142).

Mr. Fraser, on rising to read his paper, was greeted with applause.

The President: We have not heard Professor Rosebrugh's voice in Convention; I think the members here would like to hear if he has anything to say on this paper.

Mr. Rosebrugh: Mr. President, I have not had time to look over the paper at all, and any remarks that I might make might be premature. Without further consideration I would not care to say anything.

Mr. Breithaupt: I would like to ask Mr. Fraser about the figures he gives as to the Lauffen-Frankfort transmission, as to where he gets them.

Mr. Fraser: From the official report published by Dr. Boaber, who was chairman of the official committee.

Mr. Milne: Has not Mr. Fraser drawn the arrows in diagram 12 in the wrong way? It occurs to me that the arrows are in front of the E.M.F.

Mr. Fraser: You will find the maximum E.M.F. is quite a distance from the mouth of the current.

Mr. Armstrong: If there is not likely to be any further discussion, I have pleasure in moving a vote of thanks to Mr. Fraser for his paper on this subject; it seems to have covered the whole field very fully on the subject of polyphase currents.

Mr. Wyse: I second the motion.

The President put the motion, which was carried.

Mr. Dion: I would like to call attention to two points in connection with this paper. One of the two features which give the paper particular value is the great clearness with which the phenomena of alternating currents are explained. As stated by Mr. Fraser, most of the statements on this subject are so surrounded by clouds that it is difficult for any but the advanced student to properly understand them. In this particular case he has explained the action of the polyphase currents in such a clear manner that he has no doubt helped to increase the knowledge of many members present. The other feature which I think deserves particular attention is his plea for good engineering, and I hope to see the day when his advice will be followed, and when every particular installation will be designed according to the local conditions, and when every installation, whether large or small, will not be undertaken before consulting competent electrical engineers.

Mr. Fraser: I thank the members and I thank Mr. Dion for considering these points.

Mr. Gossler: There is one point in the description of the generation of multiphase currents, as described in diagrams 3 and 4, which I think is probably an oversight on the part of Mr. Fraser. He states at the bottom directly under diagram four, "A, B, are two coils of the armature. The angular distance of A, B is half that of N, S. When A is right under N it is generating its maximum E.M.F.; at that moment B is half way between N, S and its induction, and therefore its E.M.F. is least." I call attention particularly to this statement inasmuch as it is very important. Mr. Fraser states further, "As the armature revolves clockwise, B gradually gets into a stronger field, while A is approaching a weaker one." Mr. Fraser states there that when A is right under N it is generating its maximum electro-motive force, which is the actual condition if the armature coils are so placed as in diagram 4. While diagrams 3 and 4 have been taken as general illustrations, I think it has been an oversight on Mr. White-Fraser's part, as this illustra-

tion can only apply to two-phase generation. If the coils are so placed that B is half way between N, S, it must necessarily mean the generation of two-phase currents 90 apart. It would alter diagram 3 to such an extent that the minimum point of curve 2 would be directly under the maximum point of curve 1, which is the condition of multiphase currents of ninety degrees apart. I think this illustration will only apply to the generation of currents ninety degrees apart.

Mr. Fraser: If you take diagram 3 in connection with diagram 4, your idea is correct. It is not a quantitative so much as a qualitative diagram.

Mr. Gossler: It is a trifle misleading if you combine diagrams 3 and 4, because it is not a general case.

Mr. Fraser: I have not specified any particular case. I think it is understood to be purely qualitative.

Mr. Gossler: There is another point in regard to the position of the armature coils which this illustration can be made to show most beautifully—the re-action and inter-action of the coils on the armature, due to their relative positions, as affecting regulation. The regulation question is a very serious one and a very important one, and inasmuch as the diagram shows it so beautifully I thought possibly it would not be out of place to bring it to your attention. If the coils as placed in diagram 4, and as stated, when A is directly under N it is generating its maximum electromotive force, and B being half way between N, S, the electromotive force is minimum, then when the current in A is maximum there can be no current in B, consequently there can be no induction from B to A. The effect on one side of the coil B from A is the same as on the other side, they being symmetrical to coil A, so that the two conditions taken together show the impossibility of any action between the two phases; the practical demonstration of the fact of their being no influence on regulation from one phase to the other in two-phase generators is borne out by every day practice. If we pass further on from two-phase apparatus to multiphase apparatus, Mr. Fraser mentions the possibility of placing three or four or any number of coils in a similar space, but the four coils are of no practical use. If we consider the space between N, S, divided into three spaces so that we have three coils placed there, we have a generator generating three-phase currents. If we divide that space so that it is divided into three and apply the same reasoning as above, the coils not being symmetrically or relatively inductively placed to each other, there is but one condition in a three-phase generator in which the mutual induction or re-action of the armature coils is equal, and that is when the coils or phases are equally loaded. When they are not, on account of this re-action of the armature coil, one coil of the armature acts as the primary of a transformer, while the other two coils act as the secondaries of a transformer. When the phases of a three-phase apparatus are not equally loaded there is a transformer action which necessarily boosts up one side of the circuit and decreases the voltage on the others.

Mr. Fraser: I have been very careful to avoid any comparison of the two methods.

The President: We will now have Mr. E. J. Phillip's paper entitled "Operating Engines without a Natural Supply of Condensing Water, or the Continuous Use of Injection Water." I am sorry Mr. Phillip is not here, but Mr. Wickens will read his paper.

Mr. Wickens: I regret Mr. Phillip is not here to read this paper himself. He has given some considerable time and study to this particular arrangement, and hopes to install a considerable plant under this style. I really regret that he is not here to read this paper himself, because should any discussion occur, he would be very much more capable of taking up the points than I will. There is another thing that I would call the attention of the members to before reading this paper, and more especially to those of us who have been attending the conventions straight along, and that is as to the scope of the papers that have been read. There is no question in my mind that the papers read at this Convention have been somewhat an advance on any of the others, and of

course in an Association whose scope is so great and which reaches out so far as this, the papers must necessarily cover a very large ground; and while, it seems to me, in a measure the interests of the larger establishments have been held forth, the interests of a very large number of the smaller plants throughout Canada have been taken into account. The other day, in conversation with a gentleman who had travelled largely in England and also largely in Canada, he said that one of the first things that attracted the attention of an Englishman in Canada was the fact that the small hamlets were lit up with electricity. That means that we have a large number of small plants scattered throughout Canada, and we should have a large number of the proprietors of those small plants attending our Convention; and I honestly hope the members that are here to-day and the incoming Executive will make a special movement to get a large attendance of that kind next year.

Mr. Wright offered the use of his steam yacht for a sail on the lake at three o'clock.

The President: Mr. Wright has a very handsome steam launch, and if any of you can make it convenient to go you will find it very pleasant.

Mr. Wickens: The title of this paper is "Operating Engines without a Natural Supply of Condensing Water, or the Continuous Use of Injection Water." (See page 152.) This is coming to be very vital as far as the steam end of electrical plant is concerned.

The reading of the paper was greeted with applause.

Mr. Wright: I am sure the Association is indebted to Mr. Phillip for the getting up of this paper. The subject, it seems to me, is far too important a one to bring in and discuss at this late stage of the proceedings of the Convention, and I would like to suggest that a request be made to Mr. Phillip by the Association or the Executive Committee to amplify this paper and bring it before us again at our next Convention, when I think we shall have more time to discuss it and do it the justice that its importance demands.

Mr. Wickens: There is one thing I would like to call the attention of the members to. Mr. Phillip, unfortunately, is not a member of this Association, although he has intimated his intention of becoming a member, but for some reason or other he did not get his application in, and I would like to have the secretary forward him a vote of thanks from this Association. He is one of our bright young men in the city of Toronto.

Mr. Armstrong: I should like to move a vote of censure to Mr. Wickens for not seeing that Mr. Phillip was a member of the Association. However, I will withdraw it.

Mr. Wickens: We put the proposition in, but for some reason or other it was skipped.

Mr. Hopkins: The H., G. & B. Railway have adopted something like this. They had a great deal of trouble deciding where they would locate their power house. I understand they never had a proper inspection made previously to locating their power house, to find whether they could get water there or not. They had the power house built and then tried to get water for condensing their engine, and then afterwards they found they could not very well get it. They dug down a deep hole through very sticky clay, which was a very expensive operation, and this seemed to answer the purpose very well; but this big hole was filled by water coming down from a creek and this was very muddy in the spring of the year. They found that the water would run down very fast and freely soak into this clay, with the result that it would not be full enough to supply them, so they put a pipe low down, I think about a foot or something like that in diameter, to connect the bottom of this creek with this hole. The result was that the water going in was very, very dirty, and full of grit and sand; then, in midsummer this place dried up completely and they were without condensing water, and in fact, without any water at all. They hauled water for a while with a team for their boilers, and the finally, when they got tired of that, rented the power

from Hamilton and had the water transferred down seventeen miles. That is one example of this. They used the water in such a way that it would cool itself afterwards by running out in a trough and then running down. This trough was leaky and let the water escape and cooled it very well. After they found that the hole wouldn't supply water in the summer time, and as they didn't want to rent power from the Hamilton Street Railway Company again, they dug a deep well, and when they dug that they found out that the water was all full of limestone and calcium sulphate, and it did a great deal of harm. I mention this to show that in many cases it would be very well, but here is a case where it did not work very well, but it is better than if they didn't have it.

Mr. Ashworth: I might say a few words which would possibly be of interest to Mr. Phillip when he comes to amplify the paper, which has just been suggested. The first thing I notice in his paper which attracted my attention, was the proposed cost of condensing apparatus, which is set down at \$300. Personally, I know from having bought one or two condensers that it is impossible to get a condenser for a plant of one hundred horse power for anything like \$300. I think it would be low enough if we say \$600. Another thing is, that in his calculations he does not allow anything for the immense cost of pumping water from the top of high buildings, which one would imagine would be certainly considerable. However, that is something which he may further explain in his paper. I personally have been connected with a plant which is using water for condensing purposes in a town out west, and in that town we had no means of getting water at all. We had a spot which was supposed to have water underneath it and we found out it hadn't any.

A voice: What had it?

Mr. Ashworth: Principally oil. Oil is not very good for cleaning boilers. As luck would have it, behind this place there happened to be a large number of underground tanks, and we conceived the idea of using the water from these underground tanks, which contained probably about 20,000 barrels of water. We pumped the water from the nearest of these tanks and discharged it into the farthest, some 300 feet away, by means of a long low trough in which there were a number of cleats with sawed edges, which apparently distributes the water very well, and we get the water at a comparatively low temperature; in fact we experience a great saving by it, and we find instead of having to buy water, as we did in the summer time, we get enough water from these small wells we have, and it has greatly diminished the expense in almost every particular. Of course, the original installing expense is considerable. This makes me think that if any scheme could be devised for obtaining this, I think it would be a very good thing. It would be of interest to central station men throughout the country if Mr. Phillip would, as has been suggested, amplify his paper and present it at some future Convention.

Mr. Wickens: I understood he got the figures from one of the steam pump makers, and they are the figures he gave him. We have in his city a large institution, and they have for several years run upon the principle of using the water over and over again from a set of tanks. The difficulty in that case was the expense of putting in all these tanks and the ground occupied. The slowness by which the water cooled made the investment too great for an ordinary small plant such as Mr. Phillips has attempted to represent in his paper. The fact of being able to run your water in such a way as would cool it in any ordinary tank, makes it necessary to have very many more times the quantity of water to do your cooling than you actually need. In this case represented in the paper you only require the actual quantity of water you are pumping in your pipe to evaporate your steam. The air is the cooling medium and not the water. As in the case referred to by my friend, it is not calculated that the water is the cooling medium. The water is only a means to an end.

The President: The suggestion by Mr. Wright that

we have this paper over again at Niagara Falls at our next Convention, is a very wise one. By the kindness of Mr. Dunstan, of the Bell Telephone Company, I am permitted to say that any of the individual members (we can hardly go in a body) who care to visit the Bell Telephone Company's exchange and inspect the switch board and the operating room and so on, the company will be pleased to see them at any time.

Mr. Dunstan: Unfortunately for myself, and unavoidably so, I was not present at the session yesterday when the election of officers took place, and the members of the executive were elected. On looking over the lists I cannot but feel great regret that the City of Ottawa is not represented. I am sure that that has occurred simply by some unfortunate oversight in not presenting to the meeting the name of the Ottawa members. Remembering, as I am sure we will, the splendid work of our Ottawa friends last year and the brilliant results which they accomplished, I cannot help but feel, as I said before, great regret that the omission occurs. I am sure I can say this without it being understood in any way as a reflection upon any of those who were yesterday elected to the positions, and I would myself be only too willing to resign my position on the Executive if it could be filled by some Ottawa member. I am sure, as I said before, it can only have been by some oversight in submitting the names to the meeting that the omission took place, and I would not, for a great deal, that the impression should go abroad that we had in any way forgotten the efforts which were made on behalf of the Association in Ottawa last year, or that the impression left on our minds then had been obliterated by intervening time.

Mr. Dion: As a representative from Ottawa I may say that I was a little disappointed yesterday when I found that no representative from our city had been elected to any position on the Executive Committee. Not that I personally wished the honor—there were other candidates besides myself nominated from Ottawa—but I do not like the idea of going back to Ottawa and give the impression that the presence of the delegates who are here now has had the effect of reducing the representation of three last year to zero this year. I am very thankful to Mr. Dunstan for his thoughtfulness in mentioning this matter. I do not cast any blame on anyone. I suppose it is difficult to arrange the representation so that there will be representatives from each centre. There are many other considerations, no doubt. However, I am very thankful for the reference.

Mr. Wright: The difficulty appears to be that the election of the Executive Committee is made at large. If we had certain representatives from each district we would have no difficulty, but it is owing to the plentitude of good material that the omission seems to have occurred. I deplore just as much as anybody that we have no representative from the city of Ottawa. It is easy to see how it has occurred. It is in balloting for the members, which, you may say, is almost a matter of chance, in a way. I would not like to see any member who was elected yesterday by the Association resign his position. That, it seems to me, would be out of place. But I am certain if any way can be suggested by which a representative can be obtained from Ottawa, it would be well.

Mr. Black: I think we were led into trouble by the previous elections. I noticed when we were electing the principal officers, the President and two Vice-Presidents were all out-of-town members, and the Secretary was the only officer residing in Toronto, where the headquarters of the Association is. On the other hand, it was desirable to bring in a gentleman from Niagara Falls, and a gentleman from further west, and the impression seemed to get abroad then with the members that it would be desirable to have the executive members, if not in Toronto, very close to Toronto. I know this year our Executive has been very scattered and we have had difficulties in getting a quorum. Mr. Breithaupt and myself have come to Toronto every time when an Executive meeting was required. I think that some of the meetings had to be postponed on account of the members not attending, and I think that is how the

matter has been brought about. As one of the scrutineers, I may say that the elections were all very close; they ran almost neck to neck, with very few exceptions, so that there was nothing personal to anybody. But I was about to suggest, as I have been on for several years, if there is a sufficient number to make a quorum without meeting, that one of the gentlemen should be elected before we adjourn, to show our good feelings towards them. They stood right royally by us last year.

Mr. Armstrong: I think there is no doubt at all that the reason there is no representative elected from Ottawa lies in the fact that there were three gentlemen from Ottawa nominated; it was not the feeling that Ottawa should not be represented, but the votes were scattered amongst three.

Mr. Dunstan: I think there is no doubt that it was an accident pure and simple, and that it is regretted by the members of this Association, and I believe that the Ottawa members will understand it in that way. I think Mr. Armstrong's suggestion is the correct one. As I said before, I was not personally present, but I think that probably the vote was simply split, and the elections, as Mr. Black stated, being close, the result of this little scattering simply resulted, unfortunately, in not any one of the three being elected from Ottawa. Mr. Black has stated that he would like to resign. The difficulty of the position is not so much in resigning, but possibly in getting an Ottawa gentleman to accept the position if a nomination was made. If I felt sure that a nomination would be accepted on those premises, I would at once place myself as resigning. I therefore hesitated to press that very strongly. If any vacancy should occur during the year, there is no doubt it will rest with the Executive Committee to fill that vacancy, and I think you will find that it will go to Ottawa.

Mr. Hunt: Is there anything in our Constitution by which we can increase that number? If there is, I would like to make a motion to that effect.

The President: The Constitution distinctly states that the Executive shall consist of ten members.

Mr. Dunstan: It cannot even be changed on the same day, because no change of the Constitution can take place on the day on which a motion is introduced, and as this is the last day of our session, we can't make a change; otherwise I would have made a motion on the same line as Mr. Hunt's suggestion.

Mr. Dion: I am very thankful to the gentlemen who have offered to sacrifice themselves for the satisfaction of the Ottawa members, but I do not think we can avail ourselves of any such offer as that. I think we may let the matter drop. There is one thing I would like to mention while the subject is up, and it is this: Mr. Black spoke as if there was a feeling that owing to several of the officers being non-resident of Toronto, a certain number of the Executive should be Toronto men on account of the convenience there would be in getting them together during the year. There must be great difficulties in getting meetings and in doing business, when the Executive is scattered all over the country, but that is a difficulty which exists in all associations of this kind. There is no way out of it, except to elect members from one city all the time, that is, where the Association has its headquarters. This would be sure to bring dissatisfaction and it is hardly practicable, therefore the only other way seems to be to let the Executive be scattered and make the best of it. If it is to be scattered, I think it ought to be well scattered, because there is this view of it, that every member of the Executive Committee is an active member of the Association in his own district, and I think in scattering the members throughout the important centres, the Association might probably be benefited. I merely speak of it as a matter of general policy for the Association.

Mr. Armstrong: I think the whole difficulty in connection with this is on account of our present mode of election, which practically restricts us. It means the continuance in office of five members of the existing board, and it limits the choice to that extent. I think it would be probably better to have an election of five members annually to hold office for two years. I think the present mode of election accounts for such a result as we had yesterday.

Mr. Breithaupt: I think the suggestion of Mr. Armstrong in relation to the changing of the Constitution is very timely. Yesterday I raised the question as to how the election ought to proceed, because I was under the impression that it had to proceed that way. Now the thing is somewhat mixed up, and we all got a little confused in the election. As Mr. Dion has said, I think it would be a very wise plan to have the members of the Executive chosen from different parts of the country, as much as possible, so as to create an interest, and we would have live agents all over to advocate our cause.

Mr. Fraser: I think we can divide it up in sections and make this Association more of a national character; for instance, in West Ontario and Toronto and Montreal, and in Ottawa—whatever sections are decided upon. I think the representation would be better, and the interest in the Association much better, by having responsible agents, so to speak, or Executive officers, in various parts of the country. I think it would greatly widen the scope of the Association, and everybody would take a great deal more interest in it than they do now when the people seem to think it is purely an Ontario Association.

Mr. Wickens: As a member who assisted in revising this Constitution, I may say that the committee took considerable pains to adopt what they considered the best plan on which to arrange and elect their Executive

board. It was felt at that time that it was really in the interests of this Association that there should be some members continually on the board, for which reason the present plan was chosen and a report made at the last Convention, and it was unanimously adopted at that time.

Mr. Wright: I rise to a point of order. It is entirely out of order to have this discussion on the Constitution, and no resolution or notice of resolution before the Convention.

The President: Mr. Wright is quite right.

Mr. Dunstan: I wish to move that the President vacate the chair for a few moments and that Mr. Breithaupt act as chairman.

Mr. Breithaupt took the chair.

Mr. Dunstan: I move that a hearty vote of thanks be tendered to Mr. Smith, the retiring President, for the very able and efficient manner in which he has performed the duties of his office during the past year, and for the capable manner in which he has presided over the various sessions of this Convention. If the day were not so hot and time were not so pressing, there is much that I could say to you about the splendid work that Mr. Smith has done for this Association, both before he was elected to the Presidency and during the time he has acted in that capacity; and, if I may anticipate a little, what he will do in the future. But that is all apparent to you as it is to me; it is fully realized by every member of this Association. I think I will content myself by moving a very hearty vote of thanks to Mr. Smith, and I am sure that the motion will receive your hearty support and approbation.

Mr. Black: I have great pleasure in seconding the motion.

Mr. Breithaupt: It has been moved by Mr. Dunstan, seconded by Mr. Black, that the services rendered by Mr. A. B. Smith during the past year, and the services he has rendered the Association throughout, be recognized by passing him a hearty vote of thanks, and I will ask all who are in favor of the motion to signify by a rising vote.

The members of the Convention arose in a body to their feet and the motion was carried with applause.

The President: Gentlemen, I simply wish to thank you. I know you mean it, and I am sorry that the man who preceded me in office as President did not bequeath to me his eloquence. I assumed the office with fear and trembling, and conscious of my inability; yet, I was willing to do the best I could to further the interests of this Association. (Applause.)

Mr. Breithaupt: Before we adjourn I think we should pass a vote of thanks to Mr. Milne for giving us the very instructive and interesting lecture on "Radiant Matter" which we had on the evening of the first day of the Convention. The lecture was certainly very instructive and of very great interest, and particularly so at the present time.

Mr. Hunt: I have much pleasure in seconding the motion. I enjoyed the lecture very much.

The President put the motion, which on a vote being taken was carried.

Mr. Wright: I have great pleasure in proposing that the thanks of the Association be given to our Secretary for his painstaking and conscientious work during the past year.

Mr. Armstrong: I second that.

The President: Everybody in the room ought to second that.

The motion was carried unanimously.

Mr. Mortimer: I cannot but feel that the work I have tried to do is appreciated, and if it is not as good as I have tried to make it, it cannot be helped.

It was moved by Mr. Dunstan, seconded by Mr. Fraser, that the thanks of the Association be tendered to the Toronto Electric Light Co. and the Toronto Railway Co. for having permitted an inspection of their power stations by the members and friends of the Association.—Carried.

Mr. Wickens: I move a vote of thanks to the management of the Board of Trade building for the very comfortable quarters we have enjoyed and the very courteous treatment we have received during the time we have had our Convention in this building.

Mr. Armstrong: I second that.

The motion was carried unanimously.

Mr. Armstrong: I have much pleasure in moving a vote of thanks to be tendered to the press of Toronto for the good reports that have appeared in their issues. I have no doubt that the pressure of political matter has interfered with the giving of fuller reports of our proceedings.

Mr. Black: I second that.

The President put the motion, which was carried.

The President: I think, gentlemen, that is all. I wish to thank you very sincerely for your close attention. The Convention has been a success from the point of attendance and also the interest taken in the papers, and it augurs well for future Conventions. Personally, I feel sorry that Ottawa has been omitted from our list of the Executive. I did not want to refer to it, but several spoke of it yesterday, and the speakers were all Toronto men. It was an unintentional accident. I declare the Convention adjourned.

EXCURSIONS AND BANQUET.

Upwards of one hundred members and guests of the Association proceeded to Lorne Park per steamer "Greyhound" on Thursday evening and participated in the annual banquet at the Hotel Louise, returning to the city about midnight. A very pleasing feature of the return trip was the presentation by Mr. Higman, on behalf of members of the Association, of a gold-headed cane to Mr. A. B. Smith, the retiring President.

On Friday afternoon an enjoyable time was spent by a number of the members and their friends on board the steam yacht "Electra," by kind invitation of the owner, Mr. J. J. Wright.

MR. JOHN YULE.

THE honor of becoming President of the Canadian Electrical Association was, at the recent convention, bestowed upon Mr. John Yule, of Guelph, whose portrait appears on this page. Previous to coming to Canada Mr. Yule was for ten years connected with the Dundee Gas Company, of Dundee, Scotland, and for two years with the Dundee Municipal Gas Works. Shortly after coming to Canada, over twenty-five years ago, he assumed the management of the Guelph Gas Company, which position he still holds, the name of the company having since been changed to the Guelph Light & Power Company. During this extended term under the direction of Mr. Yule, the company has attained a marked degree of prosperity. He is said to enjoy the entire confidence of the directorate and shareholders of the company, and the respect of the citizens generally.

The newly-elected president has been prominently connected with the Canadian Electrical Association since its inauguration. He was one of the committee appointed to formulate a scheme of organization in 1891, and was elected a member of the Executive Committee upon the formation of the Association, serving as such until September of last year. He is deeply interested in the advancement of electrical industries, and it is safe to say that the affairs of the Canadian Electrical Association will be ably conducted under his direction.

AN INTERESTING LEGAL SUIT.

THE decision in the case of the Bell Telephone Company vs. the Montreal Street Railway Company, which was given last week, is of much interest to electric railway and telephone companies.

The Bell Telephone Company entered suit against the Montreal Street Railway Company, claiming \$30,000 damages, on the ground that the introduction of the electric trolley car system into Montreal in 1892 caused, and has been causing ever since, a serious disarrangement of the telephone service, and necessitated the adoption of a number of expensive contrivances to counteract the effect of the presence of the trolley wires, with their attachments, which would otherwise have caused the diversion of currents running along the telephone wires, the area adjacent to the trolley poles being always charged with electricity, which naturally would have impaired the efficiency of the telephone service, if the Bell Company had not gone to considerable extra expense. For this extra expense it is now claimed to be indemnified as above, up to the date of the entering of the action with reserve of claims for further subsequent damage.

The Street Railway Company's main plea was to the effect that, in establishing the trolley system, it had acted within the rights granted it under its charter with the city of Montreal, and that it could not be held liable

for any damage incidentally suffered by the Bell Telephone Company.

The hearing of the case was commenced in the spring of last year, and occupied ten days, during which a great deal of technical evidence was heard.

Judge Davidson last week gave judgment, dismissing the action of the Bell Telephone Company.

DEATH OF MR. EDWARD LUSHER.

Mr. Edward Lusher, secretary-treasurer of the Montreal Street Railway Company, died on the 11th of June, at the advanced age of 71 years. The deceased had for upwards of fifty years been prominent in business circles, and was probably the oldest railway man in Montreal. For eighteen years he filled the position of secretary and general manager of the old horse car system. Upon the reorganization of that enterprise three years ago, Mr. Lusher took the position of secretary-treasurer, which he has held up to the present time.

In 1885 he was elected a vice-president of the American Street Railway Association, and it was mainly through his endeavors at the convention in Milwaukee in 1893 that the session was held in Montreal last October.

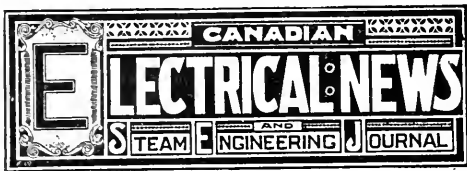
The history of street railroading in Montreal from its very inception many years ago, was really a portion of the life-history of Mr. Lusher. He saw the Transportation Company in Montreal grow from a couple of miles of track on Notre Dame street, with its homely old cars and crude track, into the extensive system of to-day. For a man of his years Mr. Lusher was wonderfully well preserved, and looked and acted many years younger than he really was.

In his death the company lose a valued and faithful servant.



MR. JOHN YULE,
President-elect Canadian Electrical Association.

ADVANTAGES OF ELECTRIC LIGHT IN BAD AIR IN MINING.—The results of some recent experiments of Dr. Haldane have been made public. They refer to the presence of black damp; he finds that when the percentage of oxygen has fallen to 17.64 a candle is extinguished; at 3.38 per cent. of carbonic acid gas, and 15.3 per cent. of carbonic oxygen his respiration began to deepen, and at 7.32 and 9.62 per cent. respectively there was violent panting; at 7 per cent. of oxygen consciousness would probably have been lost. He thus shows that there is a wide margin between the point of the extinguishing of a lamp and the point of danger to life; a miner provided with an electric lamp could therefore penetrate with impunity or escape through atmosphere containing at least three times as much black damp as would extinguish a lamp and the difficulty of respiration would give ample warning if the electric lamp did not.



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EDITORS' ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. John Fox, President; Chas. Moseley, Vice-President; T. Eversfield, Recording Secretary, University Crescent.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, John Murphy; 1st Vice-President, J. E. Huntington; 2nd Vice-President, Wm. Smyth; Secretary, B. Archibald York; Treasurer, Peter McNoughton.

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BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Maclellan's Hall, Wm. Norris, President; E. Teeter, Vice-President; Jas. Ironsides, Corresponding Secretary.

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LONDON BRANCH NO. 5.—Meets once a month in the Huron and Erie Loan Savings Co.'s block. Robert Simmie, President; E. Kidner, Vice-President; Wm. Meaden, Secretary Treasurer, 133 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30 p. m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; F. Merrill, Secretary, 338 Wellington street.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. J. R. Uley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King street, at 8 p. m. President, S. Donnelly; Vice-President, Henry Hopkins; Secretary, J. W. Tandin.

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CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

It has been found necessary to largely increase the size of the present number of THE ELECTRICAL NEWS in order to

admit of the publication of a complete report of the annual convention of the Canadian Electrical Association held in Toronto last month. The proceedings are of such an interesting and instructive character, and cover such a wide range of subjects in which our readers may be supposed to be interested, that we deem it scarcely necessary to apologize for the monopoly of space accorded to their publication. Of the convention it can be said, that especially in respect of interesting and instructive papers and discussions, it was a decided advance upon any of its predecessors. A higher average attendance at the sessions, and a deeper and more general participation in the proceedings, were encouraging features of the occasion. The use for the first time of lantern slide projected diagrams for the illustration of the papers had the effect of awakening a more general and deeper interest on the part of the members in the subjects under consideration. The addition of a considerable number of new members mainly from the ranks of the central station men is a cause of congratulation, and may be taken to indicate an awakening appreciation of the efforts which the Association has made to prove helpful to the electric lighting interests in conjunction with those of the telephone and telegraph. It is to be regretted that the various sections of the Dominion are not more equally represented on the Executive Committee, and especially that the city of Ottawa, whose generous hospitality can never be forgotten, is entirely without representation. We are sure that this and one or two other apparent blunders were due to lack of proper consideration, rather than deliberate intention. The result, however, is none the less regrettable, and care should be exercised to ensure justice being done in future to every individual and locality.

Mr. D. A. Starr has been appointed engineer in charge of the Hull and Aylmer electric railway.

The announcement has been made that the Babcock & Wilcox Company will consolidate their Canadian office with their general sales department at New York. From their various offices at Buffalo, Boston, New York, Minneapolis, Chicago, Cincinnati and San Francisco, it is believed that their Canadian business can be properly looked after, at much less expense. Mr. Wm. T. Bonner, formerly manager of their Canadian office in Montreal, will remove to Atlanta, Ga., having been appointed manager for the south-eastern territory. The Canadian shops will be maintained, at which boilers will be manufactured as usual.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

THE annual meeting of the above association was held at Galt on the first of June. Mr. Arthur Ames, president, occupied the chair. There was a good attendance and much interest manifested in the proceedings. The minutes of last meeting were read and approved.

The president, in his address, impressed upon the members present the great importance attached to the various offices, and urged that care be exercised in the filling of such, as the success of the association depended to a large extent upon its officers and members. The interests of the engineers of this country depended largely, he said, on their own endeavors to procure an education in the principles involved in operating a modern steam plant. The rapid strides made almost daily in the advancement of this science make an up-to-date knowledge of these facts indispensable. And it is being recognized that the opportunities offered by this and other similar societies, together with the various publications connected therewith, greatly facilitate the acquiring of such a knowledge. The association had progressed very favorably; 150 certificates having been issued by the registrar for the current year, making in all some 700 now in force in this province. The reduction of renewal fees on two previous occasions had a beneficial effect, but they were now as low as possible consistent with the proper carrying out of the affairs of the association. In connection with legislation, a joint committee from this association and the Canadian Association of Stationary Engineers was appointed to draft a measure, to be presented at the last session of the Ontario Legislature, to procure a compulsory law, but the very laudable attempt fell through, owing to lack of sufficient time. He hoped that further action in this direction would shortly be taken. Apalling boiler explosions have been frequent of late, attended by great loss of life, and he would ask that a joint committee of the Ontario and Canadian Associations be appointed to draft a workable measure such as will comply with the interests of engineers and steam users at large. He thought the steam users of this province were beginning to realize that the aim of these associations is to place before them competent men, a very important matter in these days of close manufacturing competition. With respect to the financial standing of the association, the president stated that considerable money had been spent in procuring a set of books for the registrar and treasurer. He asked the members to consider the advisability of changing the regular date of meeting to the 24th of May, as it would afford a greater number the opportunity of attending.

The committee on "Good of Order," Messrs. Wickens, Donaldson and Stott, presented their report, which recommended that the question of securing legislation be again taken up this year upon new lines, and that the registrar be requested to call in all certificates out of date, and endeavor to collect the fees due.

The registrar, Mr. Edkins, presented his report and financial statement, the latter showing the receipts for the year ending 31st May, 1896, to be \$641.41, and the expenditures \$613.11, leaving a balance on hand of \$28.30. The report stated that the success of the association was reason for congratulation, when the general depression in manufacturing industries was considered. During the year many certificates had been issued to craftsmen having charge of isolated plants, who volun-

tarily came up for examination in order to prove themselves qualified to act in the capacity of stationary engineers. Since the last yearly meeting three valued members had been called away, Messrs. B. Charlesworth, Hespeler, J. H. Walker, Paisley, and E. Edwards, Merriton. The association had at the present time a membership of about 600, but of these many were in arrears in the payment of fees, of which 59 were third class, 27 second class, and 6 first class. He asked instructions as to the course to be pursued to secure payment, and suggested the advisability of arranging the yearly renewal fee as follows: \$1.00, 75c. and 50c. for first, second and third class respectively, if paid on or before the last day of February each year, and in default of so doing, the fees to be respectively \$1.25, \$1.00, and 75c. This arrangement would result in making members more prompt in payment. The fact that advertisements had appeared in the daily press asking for engineers holding Ontario certificates was considered encouraging.

The report of the treasurer was then read and adopted, after which the association adjourned for lunch.

At 2 p. m. order was again called, when the Committee on Legislation reported that after a good deal of work they had decided to postpone their efforts to secure legislation until the session of 1897.

The auditors' report was then presented and received.

Nominations were received to fill vacancies on the Board of Examiners as follows: Messrs. J. Bain, J. Devlin, F. Donaldson, F. Mitchell, P. Stott, and W. Sutton. A ballot being taken, it was declared that Messrs. Devlin, Donaldson and Mitchell were elected.

In the election of officers Messrs. Ames, Mitchell and Phillips were nominated for president, and Messrs. Devlin, Phillips and Mitchell for vice-president. Mr. Ames was declared elected for president and Mr. Mitchell for vice-president. Mr. Edkins, registrar, and Mr. Mackie, treasurer, were re-elected by acclamation.

Toronto was chosen for the next meeting place, and after discussing the question of changing the date, it was decided to adhere to the first Monday in June.

It was decided to memorialize the Dominion Government to appoint Mr. James Devlin as chief engineer of penitentiaries. A delegation, composed of Messrs. Devlin, Wickens and Edkins, was named to interview the same government on the question of obtaining a compulsory law for engineers.

It was moved by Mr. Phillip, seconded by Mr. Devlin, that the position of registrar in future should have a yearly salary of \$100 attached thereto. The registrar stated that he would decline the position if any salary was voted.

Messrs. Cowan and Turnbull addressed the meeting, expressing themselves strongly in favor of the objects of the association, after which adjournment was announced.

An accident recently occurred to the dynamo in the power house of the Winnipeg electric railway which necessitated taking off some of the cars until repairs were made.

The Lachine Rapids Hydraulic and Land Company have decided to increase the capital stock to \$2,000,000 and to proceed at once with the construction of the conduit and distribution in the city.

On June 19 fire was discovered in the works of the Thompson Electric Company at Waterford, Ont., which completely destroyed the building and machinery. The loss is placed at \$30,000, about half of which is covered by insurance.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

THE ANNUAL CONVENTION.

Arrangements are being made for the holding of the annual convention of the C. A. S. E. in Kingston on the 18th and 19th of August. It is expected some interesting papers will be presented, and the question of meeting in convention once in two years, instead of every year as at present, will probably come up for consideration. The local association are already arranging plans for the reception of delegates, fuller particulars of which will be given in our next issue.

MONTREAL NO. 1.

The election of officers took place at the meeting of the above association on June 18th, with the following result: President, John Murphy; 1st vice-president, J. E. Huntington; 2nd vice-president, William Smyth; secretary, B. Archibald York (re-elected); treasurer, Peter McNaughton; fin. secretary, Harry Nuttall (re-elected); corresponding secretary, Hugh Thompson (re-elected); conductor, John Glenmor, (re-elected); door-keeper, Wm. McAlpin (re-elected); trustees, Thos. Ryan, John J. York, and John H. Garth; librarian, John Robertson.

The representatives to the executive council will be elected at the next meeting of the association.

TORONTO NO. 1.

Toronto No. 1, at their last regular meeting, elected officers as below: President, John Fox; vice-president, Chas. Moseley; recording secretary, Thomas Eversfield; financial secretary, Walter Blackgrove; corresponding secretary, George Mooney; conductor, Thomas Seaton; door-keeper, Barney Doyle; trustees, James Huggett, George Fowler, and E. J. Phillip. The delegates to the convention, to be held at Kingston in August next, are as follows:—John Bain, John Fox, James Huggett, A. M. Wickins and Charles Moseley.

HAMILTON NO. 2.

On Friday, June 19th, the above association elected the following officers for the ensuing year: Past president, W. R. Cornish; president, Wm. Norris; vice-president, E. Teeter; recording secretary, James Ironsides; financial secretary, A. Nash (re-elected); treasurer, Wm. Nash (re-elected); conductor, W. Jones (re-elected); door-keeper, Thomas Carter (re-elected); trustees, R. Mackie, P. Stott, R. C. Pettigrew; auditors, G. Mackie, James Ironsides, J. Wadge; sick committee, G. Mackie, W. Jones, Thomas Carter; delegates to convention to be held at Kingston, William Norris and G. Mackie. This association is reported to be in a thriving condition, an harmonious spirit existing among the members.

GUELPH NO. 6.

At a meeting of Guelph No. 6, at which there was a good attendance, officers for the ensuing year were elected as follows: President, H. Geary; vice-president, Thos. Anderson; recording secretary, H. Flewelling; financial secretary, P. Ryan; treasurer, C. F. Jordan; conductor, J. Tuck; door-keeper, J. Thatcher.

On behalf of the employees of the St. John, N. B., Street Railway Company, the superintendent presented Mr. George Wilson, the retiring chief engineer, with an address and handsome cigar case. Mr. Wilson thanked the donors for their expression of good-will.

PERSONAL.

Mr. H. Rawstran, cashier of the Montreal Street Railway Company, has resigned, to accept a lucrative position with a Chicago company.

Mr. C. Berkeley Powell and Mrs. Powell, of Ottawa, sailed a fortnight ago on the steamer *Parisian* for a pleasure trip in England.

Mr. M. B. Thomas has succeeded to the management of the Hamilton & Dundas Railway Company, vice Mr. W. N. Myles, who has resigned.

Mr. T. Ahearn, of Ahearn & Soper, Ottawa, is at present in England on a business trip in connection with enterprises proposed by his company in Australia.

Mr. George Yorke, engineer at Osgoode Hall, Toronto, is enjoying a wedding tour in England. Mr. Yorke was married on the 4th ultimo to Miss Sarah Robins.

Mr. Thomas Irwin, of Montreal, has been appointed chief engineer of the power house of the St. John, N. B., Street Railway, Union street, to succeed Mr. G. M. Wilson.

Mr. William McCammon, of Kingston, Ont., was drowned at Clayton, N. Y., by walking off the dock. Deceased was an expert electrician and had charge of the electrical machinery on Folger Bros.' fleet of steamers known as the "White Squadron."

Mr. W. H. Baker, Vice-President of the Postal Telegraph Cable Company, of New York, was a recent visitor in Montreal. Mr. Baker, in addition to being vice-president of probably the largest cable company in the world, having over 8,000 offices on the continent, is a well-known figure in the electrical world and has invented several electrical contrivances.

At the commencement exercises of the graduating class of 1896, from the Stevens Institute of Technology, Hoboken, N. J., held June 18th, 1896, the degree of Doctor of Engineering was conferred by the faculty and trustees of Stevens Institute upon Commodore George W. Melville, engineer-in-chief of the United States Navy, in appreciation of the excellent engineering work performed by Commodore Melville for his country and the advancement of the science of steam engineering, well illustrated in the world wide famed "White Squadron." Only once before in the twenty-five years history of the Stevens Institute has the degree of Doctor of Engineering been conferred, and then upon Professor R. H. Thurston, of Rhode Island, who formerly occupied the chair of Mechanical Engineering in Stevens Institute, and is now Director of Sibley College, Cornell University.

Mr. Horatio Whiteway Nelson, who has recently taken charge of the cable and wire department of the Royal Electric Co., Montreal, is an expert in the insulating business of long and varied experience. On completing his education he spent two years in travel around the world, and then joined the Edison Machine Works, of Schenectady, N. Y., where his work was attended with continuous success during five years. In 1889 he came to Canada with the Edison General Electric Co. and superintended the large wire department of that corporation at Sherbrooke and Peterborough for four years, when he accepted the position of general superintendent of the works of the Waddell-Entz Co., of Bridgeport, Conn., then employing some 300 men. Subsequently he was entrusted with one of the departments of Messrs. Washburn & Moen's great works at Worcester, Mass., which charge he relinquished to accept his present post.

TRADE NOTES.

J. Wallace & Son, of Hamilton, have just completed a machine for the manufacture of acetylene gas for Mr. T. L. Willson.

The Ottawa Car Company recently shipped two electric cars to the Berlin and Waterloo railway, and the same number to the Galt, Preston & Hespeler railway.

The following statement shows the geographical distribution of sales of Babcock & Wilcox water tube boilers during the month of May last, the figures indicating the horse power: American sales: New York, 774 h.p.; Pennsylvania, 300; Illinois, 6,400; Cincinnati, 330; Tennessee, 600; Canada, 1,742; total, 10,146 h.p. Foreign sales: England, 4,444 h.p.; New South Wales, 206; Scotland, 200; France, 686; Germany, 756; Spain, 722; Peru, 125; Norway, 280; Sweden, 57; Egypt, 1,728; Russia, 1,142; China, 160; Japan, 1,320; India, 46; Cuba, 75; Mexico, 64; total, 12,011 h.p. The grand total, including 1,920 h.p. marine boilers, is 22,157 h.p. The number of Babcock & Wilcox automatic chain grate stokers sold during the month was fifteen.

ACETYLENE GAS.

By GEO. BLACK.

GREAT inventions and discoveries are often apparently the result of accident, but the seizure of the occurrence and turning it to account marks the true scientist; such was the case when our countryman, Thos. L. Willson, discovered his method of producing calcium carbide, for it was known to chemists as a rare product, as shown by the following references:

Sir Humphrey Davy observed that when carbon and potassium were heated sufficiently to vaporize the potassium, a substance was formed which has been recognized as the first reference to a group of carbides.

In 1836 Berzelius announced that the black substance formed in small quantities as a by-product in producing potassium from potassic carbonate, and carbon was carbide of potassium.

Wohler in 1862 announced that he had made the carbide of calcium by fusing an alloy of zinc and calcium with carbon. He ascertained that it decomposed in contact with water forming calcic hydrate and acetylene.

Berthelot in 1866 described sodium carbide or acetylene sodium. He discovered that the high temperature of the electric arc within an atmosphere of hydrogen would unite with carbon of the charcoal terminals and form acetylene gas.

In 1888 Willson, in experimenting with his electric furnace, trying to form an alloy of calcium from some of its compounds, noticed that a mixture containing lime and powdered anthracite acted on by the arc fused down to a heavy semi-metallic mass, which, having been examined and found not to be the substance sought for, was thrown into a bucket containing water near at hand, with the result that violent effervescence of the water marked the rapid evolution of a gas, the overwhelming odor of which enforced attention to its presence, and which on the application of a match, burned with a smoky but luminous flame and numerous explosions. It was Acetylene gas.

To Willson is due the credit of discovering how to make calcium carbide, at the price of about one cent a pound in unlimited quantities, instead of the rare laboratory product obtained in grains, at the rate of about \$10,000 per pound, thus producing not only a new light, but for manufacturing and commercial purposes opening up a vast range of new combinations of hydro-carbons at a much cheaper rate than ever existed before. The dream of the Chemist has been realized and synthetic chemistry took several strides forward. The possibilities of cheap carbide for light or chemical combinations places Willson in the front rank of the scientific men of the age.

Calcium carbide, Ca C_2 , is described as a dark brown, dense substance, having a crystalline metallic fracture of blue or brown appearance, with a specific gravity of 2.262. In a dry atmosphere it is odorless, but in a moist atmosphere it emits a peculiar smell, resembling garlic or phosphorus. When exposed to air in lumps it absorbs moisture, and the surface becomes coated with a layer of hydrate of lime, which to a certain extent protects the rest of the substance from further deterioration. It is not inflammable and may be exposed to the temperature of a blast furnace without taking fire, the exterior only being converted into lime. When brought into contact with water or its vapors at ordinary temperatures, it rapidly decomposes, one pound when pure generating 5.892 cubic feet of acetylene gas at a temperature of 64° F.

Calcium carbide is manufactured from powdered lime and carbon in the shape of ground coal, coke, peat or charcoal, these two substances being fused together in an electric furnace. The process is very simple, and may be described thus:

The lime and carbon, having been ground to a fine powder, is intimately mixed in a certain proportion and fed into a crucible or furnace, the lower part of which has a carbon plate which is attached to one of the dynamo terminals; the other terminal is connected to an upright carbon resembling the upper carbon of an arc lamp, but much larger, being about three feet long and 12 by 8 inches in cross section. An alternating current is delivered by means of transformers to the carbons at about 100 volts and 1000 amperes. A small portion of the mixture is fed into the furnace, the upper carbon is raised about three inches to form an arc and the mixture is fused by the intense heat which ranges from 3500 to 4000 deg. C., while that of the ordinary smelting furnace is only 1200 to 1500 deg. C. The carbon is gradually raised and fresh mixture fed in till a mass of molten carbide about three feet high is made when the current is turned off and the carbide allowed to cool. The noise of the arc is said to be very peculiar, especially when the supply of mixture begins to fail.

COST OF CALCIUM CARBIDE.

To positively ascertain the cost of this product, the Progressive Age, of N. Y., sent three commissioners to Mr. Willson's aluminum factory at Spray, N. C., in March last, to investigate thoroughly, and their report is published in that journal under date of 16th April, 1896. The commission consisted of Messrs. Houston and Kennelly, well-known electricians, and Dr. Leonard P. Kinnicut, Director of the Department of Chemistry at Worcester Polytechnic Institute, who investigated thoroughly and took full charge of the factory during two separate days, making two runs of the substance and taking samples with them for testing in their own laboratories. Notwithstanding that the factory at Spray was only an experimental one, and the greatest possible output only one ton per 24 hours, and the fact that transportation of material was excessive, costing \$3.05 per ton for coke and \$4.55 per ton for lime, and estimating \$11 per day for labor, including a superintendent at \$4 per day, they figure the cost at \$32.76 per ton.

Messrs. Houston and Kennelly add a separate estimate for the production of five tons daily under more favorable circumstances, but with water power at \$5 per year as at Spray, and figure the cost at \$20.04 per ton. They add, "The cost of producing calcium carbide electrically, is evidently limited by the cost of lime, coke and electric power, no matter what the scale upon which the process is conducted."

"If we assume a perfect electric furnace, in which neither material nor energy is wasted, that is, a furnace which ensures the complete union of calcium and carbon without loss and with no escape of heat in the process, we know that one ton of carbide would require for its production 1750 lbs. of lime and 1125 pounds of pure coke.

"It has also been calculated from thermo-chemical data that 1½ electrical h.p. hours will be almost precisely the right amount of energy

to produce one pound of carbide, or 3000 h.p. hours per short ton of carbide.

"Consequently, if L is the cost of lime in dollars per ton, C the cost of coke per ton, and P the cost of an electrical h.p. hour, a theoretically perfect plant would yield carbide at a cost per ton, exclusive of labor and fixed charges, of $0.875 L + 0.5625 C + 3000 P$.

"For example, if lime (assumed pure) costs \$2.50 per short ton, coke (assumed pure) costs \$2.75 per short ton and an electrical horsepower of 300 working days of 24 hours each, cost \$12 at furnace terminals (to 1667 cent per working horsepower hour), the limiting cost of carbide in a perfect furnace would be \$8.73 per short ton.

"We may therefore summarize as follows: Calcium carbide by the electric furnace cannot be manufactured cheaper than \$8.73 per short ton—for material and power, exclusive of electrode carbons, labor, depreciation, interest and other fixed charges.

"Owing to impurity of materials and departure from theoretical perfection in the electric furnaces, we found at Spray the actual cost of material and power, irrespective of electrode carbons, labor, etc., is $1.335 L + 1.125 C + \$12 P$.

"Under favorable conditions such as we believe can be realized in particular localities, the total cost per short gross ton of a plant whose output is five tons daily, might be \$20. Under the actual conditions existing at Spray during our tests, we find the total cost to be \$32.70 per short gross ton if the plant were worked continuously."

In the above lowest estimate of Messrs. Houston and Kennelly they place horse-power at \$12, whereas Mr. Willson has secured water power at Spray, and also in Canada, at a cost not exceeding \$5 per h.p.

On this basis, and assuming L at 2.50, C at 2.75 and P 5.00, the figures would amount to $2.18 + 1.55 + 2.08$, or a total of \$5.81. The cost of lime and coke, however, is placed at a very low figure, but it is evident that the true theoretical minimum price is between \$5.81 and \$8.73.

I have also the following estimates of cost at the Niagara Falls establishment, to produce one ton of carbide, at rate of 10 tons per day.

It requires	200 Electrical H. P., 24 hours at \$20 per year,	\$10 00
	1,440 lbs. Coke @ \$3.50 per ton,	5 00
	1,800 lbs. Lime @ 4.50 per ton,	4 05
	Labor, Depreciation, &c., &c.,	6 18
		<u>\$25.23</u>

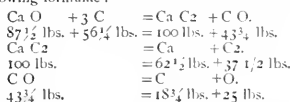
It is noticeable that this estimate is somewhat in excess of the theoretical values as laid down by Messrs. Houston and Kennelly, and may be improved on as experience is gained.

I was informed that the first run of carbide manufactured at Niagara Falls early in May gave about 25% better results than their estimate, and that they hoped to improve still more as they gained experience and the men got used to their work.

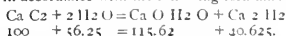
Mr. Willson commenced to erect a factory at Merritt in April on the old Welland canal, where he has secured 1500 horse-power at 8, 9, 10, and expects to turn out carbide at the rate of 7½ tons daily at the lowest possible cost. He has also secured a very large amount of power in the province of Quebec, where he intends to manufacture not only for Canada, but for export to foreign countries.

It is quite evident from the report of the Progressive Age commissioners and from the experience of the Niagara Falls Company that calcium carbide can be made and sold at a price to compete with ordinary gas and electric light.

It takes to produce 100 lbs. carbide, as shown theoretically, 87½ lbs. lime and 56¼ lbs. of carbon; of the latter 37½ lbs. combine with the metal calcium and 18½ lbs. combine with the 25 lbs. of oxygen of the lime, and escapes from the furnace as carbon monoxide, in accordance with the following formulae:



Calcium carbide contains 62½ parts of calcium and 37½ parts of carbon in 100, and when brought into contact with water acetylene is generated to the extent of 5.89 cubic feet of gas to each pound of carbide used; or by weight 100 lbs. of carbide and 56¼ lbs. of water evolve 40.63 lbs. of acetylene gas and form 115.62 lbs. of calcic hydrate (slacked lime) in accordance with the following formula:



The acetylene gas so generated contains in 100 parts 92.3 parts of carbon and 7.7 parts of hydrogen, or in the 40.625 pounds generated from 100 lbs. of carbide we have 37½ lbs. of carbon and 3½ lbs. of hydrogen.

Acetylene can be produced from carbide by the addition of water and distributed and stored in a gasometer, or the gas may be compressed into a liquid and kept in a suitable cylinder and drawn off as required for consumption, a reducing valve being adjusted to give the necessary pressure for burning. One cubic foot of liquid expands into 400 cubic feet of illuminating gas, so that a large supply may be stored in a very small space, but for experimental purposes and for a limited supply it is preferable to make the gas direct from carbide and store it in a gasometer.

The pressure necessary to liquify acetylene depends upon the temperature. At 67° it requires a pressure of nearly 600 lbs., at 32 32½ lbs., at 28.6° below zero 135 lbs., and at 116° below zero 15 lbs. We see that there is no danger of freezing it in any habitable place.

As an illuminant acetylene surpasses in brilliancy all other illuminants known. When burned at the rate of 5 cubic feet per hour it gives 240 to 250 c.p., whereas the best coal or water gas rarely exceeds 22 candles for each 5 cubic feet burned per hour. Acetylene gas thus gives 10 to 12½ times the light of ordinary gas, or 1000 feet is equivalent to 10,000 to 12,500 of ordinary gas. Acetylene is a commercially pure gas, containing 98 per cent. acetylene and 2 per cent. of air, the latter having slight traces of other substances. It is clear and colorless with specific gravity of 0.91.

When a light is applied to acetylene in open air, it burns with a

bright yellow but very smoky flame, on account of its extreme richness in carbon, but when confined and delivered under suitable pressure it gives an extremely pure white light resembling the oxy-hydrogen light, and is the nearest approach in color and purity to sunlight of any known artificial light.

ITS POISONOUS NATURE.

Acetylene, when made from expensive chemicals, was known to be very poisonous, but as made from lime and carbon it is proved to be less injurious than ordinary gases. Its strong pungent smell is a safeguard, as no one can remain in an atmosphere of it a sufficiently long time to be harmed; handy for hotels where the guests blow out the lights; in such an event the "blowhard" could not get to sleep before he or some one else would be compelled to investigate. The effect on the human system is rather to intoxicate than stupefy, and while it is absorbed by the blood it does not form combinations with it; it asphyxiates less rapidly than ordinary gas. Moissan of France and others made exhaustive experiments with the greatest care with acetylene and coal gas on animals, and proved conclusively that coal gas was much more poisonous than acetylene.

EXPLOSIBILITY.

Acetylene, when mixed with 1 1/4 times its volume of atmospheric air, becomes slightly explosive, and reaches its maximum explosibility with 12 volumes of air, decreasing till at 20 volumes it ceases to be explosive. Coal gas reaches its maximum explosibility with 5 volumes of air, so that ordinary gas is more explosive than acetylene. Accidents and explosions reported recently have given the impression that the gas is very dangerous. Let us examine this feature. Take the case of the accident in Quebec last winter. An ingenious mechanic made his own dynamo, furnace and carbide; he was experimenting with the gas under pressure, to liquify it so as to get it into the smallest possible space. He had an iron pipe 8 inches long and 4 inches diameter with cast iron ends, a pressure gauge at one end and a valve at the other. He had reached a pressure of 360 lbs. to inch, and observing that the gas was escaping around the valve, he used a hammer to stop the leak, when a portion of the metal broke away and the gas escaping struck him in the eye, penetrating the brain and killing him instantly. Ordinary air under similar conditions would have been as fatal. It was afterwards found that the iron ends were thin and porous and the wonder was that they stood the pressure. There was no explosion; the coroner's verdict was "accidental death."

The explosion at New Haven, Conn., 21st January last, was caused by men experimenting with liquid acetylene, under a pressure of 600 lbs. to the inch, and I presume all accidents reported might be traced to unauthorized parties experimenting with crude apparatus, and ignorant of the necessary conditions for safety. We know that air, water, gas or electricity, are dangerous under certain conditions, but harmless when properly controlled, and it is no argument against acetylene that it is also dangerous when improperly handled.

EFFECT ON ELECTRIC LIGHTING.

When I first saw acetylene gas in September '94 I felt sorry for the electric companies, because I thought the gas companies would readily adopt the new gas and regain their former monopoly of lighting. But I do not feel quite so downcast now; I realize that the margin of cost of production is not so great, and believe that gas companies will feel the competition equally with electric, unless they adopt the new gas for use pure, or as an enricher to their present output. It is said to be useful as an enricher for coal gas, but not so suitable for water gas.

Prof. Lewes, of England, one of the best gas authorities there, suggests that gas companies should distribute a low illuminating coal gas of about 12 c.p. through their mains for heating, cooking, etc., and that each place using illuminating gas be supplied with a cylinder of acetylene to be fed into the illuminating pipes in a certain determined proportion. By some such process as this there remains a large field for coal gas; otherwise coal and water gas must go.

The incandescent light has held first place for interior illumination on account of its steadiness, purity, coolness, and not withdrawing oxygen from the air nor adding noxious elements to it. Acetylene will divide this field with the incandescent bulb; it is a pure, white, steady light, of low heating power, withdraws very little oxygen from the air, and does not add impurities to any great extent. Its flame has a temperature of 900 to 1000 degrees C., while ordinary gas has 1400 deg. C., but as only one-tenth to one-fifteenth of the quantity is used for equal light, its heating effect is slightly in excess of the incandescent bulb.

Taking the theoretical E. H. P. necessary to produce one ton of carbide as 3000 h.p. hours, and using the same for a supply of electric light by incandescent 4 watt lamps, we have the following: $3000 \times 746 = 2,238,000 \text{ watts} \div 64 \text{ gives } 34,970 \text{ 16 c.p. lamps for one hour, or } 1453 \text{ burning 24 hours continuously.}$

The same power equals one ton carbide, which burned in 1/3 foot burners gives 11,500 16 2/3 c.p. lights, or 1313 burning 24 hours. This gives a margin apparently in favor of electric lighting, but you cannot use all your electric lights at the source of cheapest production, nor run a continuous even load for 24 hours, but have in addition to sustain losses in distribution more than proportional to the distance conveyed; also lamp renewals. With the carbide it is different; it can be made at the place of cheapest production on a constant load night and day, and a small sum transports the carbide to any place desired, where it can be used to its full power without loss. Figure out for yourselves the problem of transmitting electric current for use 10 to 100 miles from source of production and transporting carbide by freight the same distance, and the comparison will be largely in favor of carbide. Hence, for use in close proximity to the power house on a steady even load day and night, the cost will be about the same if power costs the same, but as that is not practicable in electric lighting, the margin is in favor of carbide, but not to such an extent as to seriously hurt the electric companies employing the best apparatus under the most improved conditions, as may be found in large cities, but it is possible in small towns where the best and most economical conditions cannot be obtained and a thorough manager secured, well up in the scientific as well as the practical conditions, electric lighting may suffer.

The ease of distributing acetylene is remarkable. Owing to its high illuminating power, very small main pipes may be used, and as frost

does not affect it the pipes need only be laid below the surface, so that little or no expense need be incurred in piping a town. If the cost of mains equal cost of poles and wires the central station or gas house only requires a small tank for a generator and a gasometer of suitable size, as compared with engines, boilers and dynamos running when only one light is required.

We may then conclude that in the race for supremacy closer economy will be practised, better service given, the public will be benefited, all will let their light shine to the best of their ability, and the one best deserving of patronage will survive.

POWER TRANSMISSION BY POLYPHASE E. M. F.'S.

BY GLO. WHITE-FRANER.

THE utilization of the natural resources of a country is a matter which should interest not only the engineer upon whom devolves the responsibility of their development; not only the capitalist who is on the look for investments, but the economist and the politician who have the grave responsibility of directing a nation's energies into remunerative channels.

The possession of cheap natural power, whether in the form of coal fields or large rivers, is a national asset, the importance of which it is impossible to overestimate, constituting as it does the very basis whereon rest those manufacturing industries that go towards making a nation self-supporting and progressive. The foundation of Great Britain's commercial pre-eminence is her immense coal fields, enabling all processes of manufacturing art to be carried on inexpensively, and thus giving her a very favorable start in competition with other manufacturing nations. Another favoring circumstance is that her immense deposits of iron ore, are if not in all cases contiguous to, at least very close to, the coal fields. The power, therefore, is nearly on the spot where it is wanted, and owing to her insular position, the great highway of commerce—the ocean—is at the very doors of her factories. Great Britain, probably, has ideal manufacturing and shipping facilities: raw material, raw power, natural highway, all packed into a very restricted area. In Canada, we have the three necessities—raw power, raw material, great highways,—but we rarely find them all present at the same spot. Nature gifted Great Britain from the outset; Canada must turn to science for the development and utilization and the combining of those scattered advantages. We have great and reliable water powers; we have immense natural wealth in ores, and timber, etc., and we have the highway of the great lakes and river. Governmental and private enterprise has provided, as well, railway and canal transporting facilities, but we frequently observe that the power sources are so situated as to be comparatively inaccessible to railways. Thus manufacturing establishments, in order to avail themselves of the former advantage, have to locate themselves unfavorably with respect to the latter. The cost of handling, transshipping, etc., being a very appreciable factor in the total market cost of manufactured articles, the cost of an additional link between the producing point and the shipping point, is sometimes so great as to make it commercially less expensive to locate at the shipping point even though that involves the use of a more expensive power. Any means therefore that enables cheap power to be brought to the most convenient shipping point, effects a combination which is of the greatest value to a manufacturing community. The intense competition in all manufacturing industries has the inevitable tendency to lower selling prices, and this reduction of profits must be made up either by a depreciation in the quality of the products, or by a rigid system of economy in manufacturing processes. The cost of production must go down, and any means of lowering it must be availed of. We use the most efficient machinery, we concentrate our factories round the best shipping places, we go where labor is cheapest, where power is cheapest, land cheapest, transport most handy. We do anything to save a cent in a hundred dollars; and upon the engineer frequently falls the responsibility of saving it. In his hands the policy of concentration becomes one of the principles of power generation, as in business; and power distribution receives as close attention as does the distribution of the goods. He wants to generate the power as cheaply as possible, and to transmit it to the utilizing points with the least waste; and he avails himself as far as possible of every natural advantage—natural gas, water for condensing, water falls, etc. We are all acquainted with the usual means of transmission—by belting and shafting, gears, hydraulic and pneumatic pressure, and so on; and know that the frictional and other losses by these methods are so great that very soon a limit is reached, beyond which it is not commercially possible to transmit. Hence we find, not only in manufacturing towns and villages, but even in the larger factories that several generating points are necessary, when but for these losses one very large and very efficient central generating plant might furnish all the power required throughout the entire area or district. It is, therefore, also that thousands and thousands of horse power are running to waste every day, in the many powerful rivers that drain parts of Canada. It is simply because the nearest railway, or other shipping point is so far distant from the waterfall that the power cannot be transmitted to a factory on the railway, and the extra haul and cartage would introduce an additional expense that would be prohibitory. If the power could be transmitted at reasonable cost from the water power to a convenient point on the railway, then the utilization of the cheap power and the good transport facilities might together be commercially advantageous.

It is now some years since the suitability of electricity for the transmission of power was recognized, and we have seen electrical machinery coming more and more into use, ousting other methods and proving its superiority, not only on practical but also on commercial grounds. We have seen generators grow from

25, 50, 100 h.p., to 1,000 h.p. in size per unit; we have transmitted the power at constantly increasing voltages up to 500 v. for direct currents, (or even greater in series machines,) and we have seen the direct current evolve into the alternating simple, and thence into the latest and highest type, the polyphase alternating; and to-day we find thousands of horse power transmitted at pressures of 10,000 volts, from waterfalls on a mountain, or in a gorge where it is impossible to locate a factory, and over distances ranging from a few hundred yards to thirty miles and more; we find these large amounts of energy being utilized for every industrial and domestic purpose, in units of from 1/10th to 1,000 horse power.

This tremendous widening of the field of electrical possibilities has not been attained by natural growth only. As the field widened the science developed; improved methods had to keep pace with increased demand, and while it was originally the demand that stimulated the invention of polyphase currents, polyphase currents have in their turn practically revolutionized the art of electrical generation, transmission and utilization, and the old formula $e = \frac{1}{2} i$ that was a light unto the path of the direct current man, is no longer sufficient in the calculation of alternating current circuits.

It is the development of polyphase working that has rendered commercially possible the electrical transmission of power over great distances, and its reconversion into mechanical power when required. Polyphase currents are merely ordinary alternating currents; are generated separately as such, and possess no peculiar properties in themselves. Owing, however, to their difference in phase, the fields produced by them have different values at the same instant, and it is in this alone that the peculiar properties of the polyphase system reside. As they are, however, alternating currents, all those peculiar phenomena met with in alternating current work are inherent in polyphase working, and as a rule assume an importance which claims very careful consideration. Owing also to the combination in the same circuit of several E.M.F.'s differing in phase, complications arise which are not present in single phase circuits. Before proceeding to the consideration of the mutual actions and reactions of these quantities, it may be of interest to trace the progress of evolution of electrical working from direct current, through simple alternating, up to polyphase alternating. Up till quite recently direct current was the only means of power transmission and distribution; but the limit of pressure necessarily imposed on this method was so low that the cost of copper for large areas or long distances became prohibitive, and recourse was had to the alternating current used with static transformers. By this means transmission voltage could be as high as required, and utilization pressure as low, but here again was a very vexatious limitation due to the fact that motors could not be made to operate satisfactorily on the alternating current. Once started and brought up to speed, they would go on until overloaded, and then stop; but it required some independent source of power to start them, such as a steam engine. It is quite evident that such motors could not start from rest, as each armature coil was subjected to equal forces acting in opposition to each other and therefore neutralizing each other; it was like the dead centre of an engine. This was the stationary field of an ordinary D.C. motor. This difficulty was overcome by the formation of a revolving field, and polyphase currents are necessary for this purpose. The principles of the revolving field are the same as those governing the resultant of mechanical forces acting in different directions on the same mass. Suppose a mass

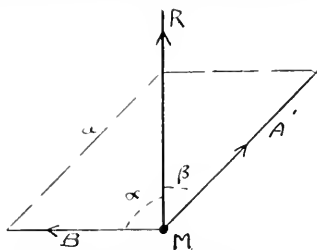


DIAGRAM 1.—PARALLELOGRAM OF FORCES.

"M" and two forces "A" "B" acting with known strength on it in the directions of the arrows. The direction in which M will be forced—the resultant direction of the forces—will be MR, which is the diagonal of the parallelogram formed by drawing parallels to A and B. Now, it is plain that

$$\frac{\text{Side } a}{\text{Side } B} = \frac{\sin \text{ angle } RMB}{\sin \text{ angle } RBM} = \frac{\sin \text{ angle } RMB}{\sin \text{ angle } RMA}$$

and as side $a = \text{side } A$, therefore

$$\frac{\text{side } A}{\text{side } B} = \frac{\sin \text{ angle } RMB}{\sin \text{ angle } RMA}$$

and that if we cause sides A, B, to vary harmonically we shall also cause angles RMB, RMA to vary harmonically; and consequently we can cause the diagonal MR to swing between positions MB and MA. Now MR is the resultant of two forces acting together; consequently if we cause these forces to vary harmonically in strength (remaining constant in direction) the resultant direction will swing as above described. Applying this principle to magnets, and an armature, we can cause the resultant magnetic field to revolve. Two electromagnets, A, B, are placed radially, and are separately energized by currents which can be varied in strength by any convenient means, say a rheostat. From the centre R of this arc, as a pivot, is hung an armature M

capable of swinging. First of all magnet A is energized, B being left dead; M is directly attracted to A, and RM is the direction of strongest magnetic pull. Then A is left alone, and B is gradually energized, and as it becomes stronger it attracts M more and

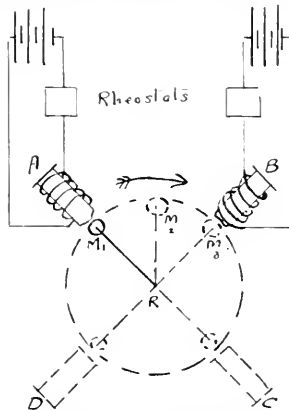


DIAGRAM 2.—HARMONICALLY VARYING MAGNET AND ARMATURE.

more towards itself, so that when B has been made as strong as A, each of them attracts M with equal force, and M will be held midway between them; RM2 being the new direction of magnetic strongest pull. If now A is slowly decreased, it will attract M less and less strongly, M will approach closer to B, the strongest direction RM3 will be the resultant pull. Thus, by causing the magnets A, B to vary in strength, one up, the other down, we have swung the resultant strongest field over the arc AB, of the circle. If we have other magnets, C, D, we could pull M all round the circle, and that is what is done in polyphase work.

The two necessary conditions for the production of a revolving field are electromagnets whose strength can be varied up and down, and some arrangement whereby adjacent magnets shall attain their maximum or minimum strength at different moments. The first condition is evidently met by energizing the magnets with alternating currents, for in this manner their strength will assume every value between a positive and negative maximum, passing through the zero point; and the second is evidently equally met by energizing two adjacent poles, by two independent alternating currents, one of which starts a little later than the other. A glance at the diagram will make this plain. Wave I

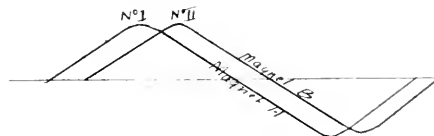


DIAGRAM 3.—WAVES.

energizes pole A, wave II energizes pole B. The current in an alternating circuit also rises and falls as does the E.M.F., and therefore the ampere turns, and consequently the magnetism. Wave II being a little behind wave I, as regards their equal strength, (strength being proportional to vertical height of wave above zero line) the magnetism in pole B will be behind that in pole A, and we have thus produced harmonically varying poles. It must be clearly understood that the principle of revolving poles is applied only to motors; the function of generators being to supply those shifted E.M.F.'s and currents. These shifted E.M.F.'s can be supplied by the same generator, or by several generators, the method employed being rendered plain by the diagram. N, S, are two

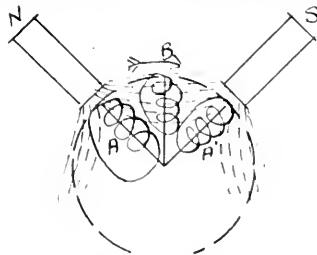


DIAGRAM 4.—GENERATION OF 2 SHIFTED E.M.F.'S.

poles—part of a ring yoke. A, B, are two coils of the armature. The angular distance of A, B, is half that of N, S. When A is right under N, it is generating its maximum E.M.F.; at that moment B is halfway between N, S, and its induction and therefore its E.M.F. is least. As the armature revolves clockwise, B gradually gets into a stronger field, while A is approaching a weaker one. The

induction, and therefore the E M F in B is increasing while that in A is decreasing; when B has got under S, its induction and therefore its E M F is greatest; at this moment A is in the midway position, and therefore its E M F is least. Therefore, in these two coils are being generated E M F's which are shifted—that is out of phase—and if we take the values of the E M F's in each at the same instant, we can construct two curves, showing the position of their maxima and minima, etc., with respect to each other. Diagram No. 3 shows these two curves. If these E M F's were taken through separate circuits and joined respectively to poles A, B, in diagram No. 2, we should have the simplest form of polyphase generator and motor. Instead of having two coils A, B, between the poles N, S, we might space three, or any other convenient number producing 2 phase, 3 phase or 4 phase E M F's. As, however, the principles of polyphase E M F's apply to any number, and there is no advantage in using more than three, we shall not consider any higher number. In a polyphased generator it is evident we can have just as many complete circuits as there are phases. In a 2 phase there are two sets of independent coils; the ends of these might therefore be brought to four contact rings, and the ends of the three independent sets of a 3 phase might be brought to 6 contact rings, as the ends of a single phase are connected to two contact rings. But a study of the wave diagrams of a 2 phase and of a 3 phase circuit show that we can greatly simplify matters, and do with less copper. Take a more simple diagram of two phase coils at right angles to each other. In the upper

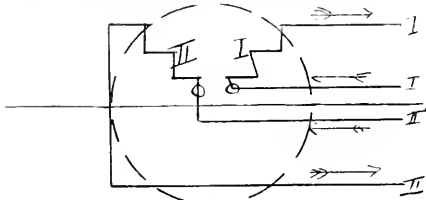


DIAGRAM 5.

half of the E M F circle, the E M F in each coil is positive and the current will flow from the outside end of the coil towards the inside end, in the direction of the arrows; here the E M F in each of the return wires is in the same direction, therefore we can combine them into one, instead of having two. Suppose the coils have revolved into the second position; here the E M F in the 2nd

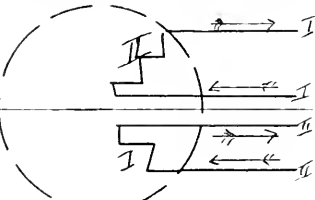


DIAGRAM 6.

coil is positive current flowing in the same direction as before. The E M F in the 1st coil is however negative (the coil being below the horizontal diameter) and the E M F will have reversed; therefore the current in 1 will now flow in the opposite direction to what it did before—in the direction of the new arrows. But it is plain that here again, if we join the outside ends of 2 and 1, the return current from 2 can flow down 1, the E M F's being in the same direction. Therefore in the two phase system instead of having two separate circuits we can join the inside ends of the coils—and

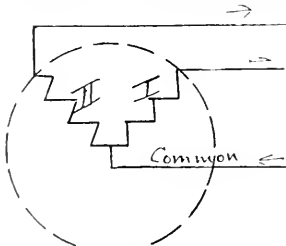


DIAGRAM 7.

lead three wires from the join—and from the two outside ends as shown in Diagram 7.

Similarly with the 3 phase system we can join the inside ends together, and lead four wires as shown in Diagram No. 8. But in this case it will be evident that we can dispense with the fourth wire altogether, as will be plain from the accompanying Diagram, No. 9, where the direction of the E M F's in the three wires at three different positions of the coils show that always two wires can help to carry the return current of the third, therefore the fourth is not needed.

But while this combining of circuits very much simplifies the matter from the above point of view, it very considerably complicates it from another, because, whereas, with the individual

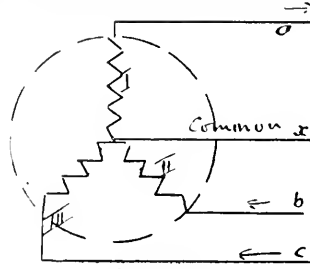


DIAGRAM 8.

circuits we had a single E M F to each, by combining them we have several E M F's of differing phase all acting in the same circuit—hence it is necessary to find their resultant E M F. This resultant

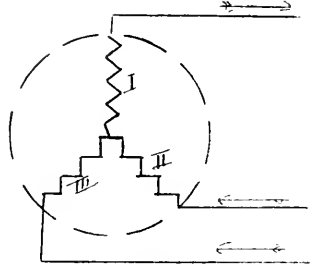


DIAGRAM 9.

depends greatly on the way in which the armature windings are connected up. There are three ways; "star" and "mesh" and independent groupings; the former is when the coils are all joined together at one end, the other ends leading to the circuits, as in Diagram No. 9. The second, where the winding is continu-

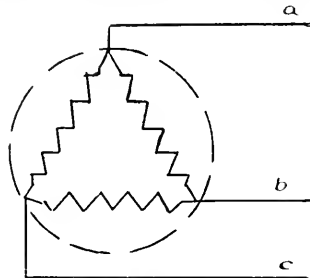


DIAGRAM 10.

ous round the entire armature and at intervals a circuit wire is tapped off, as in Diagram No. 10.

Diagram No. 11 shows 2 phase star connection, and here the

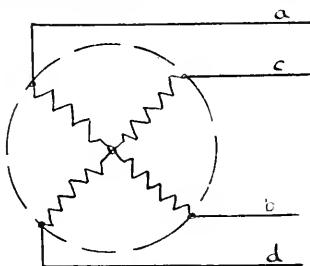


DIAGRAM 11.

instantaneous E M F between terminals a, b, and c, d, is $2E \sin O$ where E is the maximum voltage, and O is the angle through which the coil has passed from the position of no E M F. At the same instant the E M F between terminals a, c, b, d is $\sqrt{2}E \sin (O + 45^\circ)$; that is to say the pressure between two live wires of different phase is $\sqrt{2}$ times or 1.41 times the pressure between the terminals of the same coil, and is 45° in advance of the E M F of the foremost coil. If a common return be used, the pressure between either outside and the common return will be simply

double the E M F of one coil, but the pressure between the two outside will be $\sqrt{2}$ times this. If two phase coils are connected in "mesh," it is plain that between wires a, b, there is simply the ordinary voltage of coil a or E sin ϕ ; while between wires a, c, there is a voltage of $\sqrt{2}$ E sin $(\phi + 45^\circ)$; or again 1.41 times the other voltage.

Similarly with 3 phase E M F's. In star connection voltage between a and x is E sin ϕ ; that between b and x is E sin $(\phi + 120^\circ)$; that between c and x is E sin $(\phi + 240^\circ)$. The pressure between any two wires is $\sqrt{3}$ E sin $(\phi + 30^\circ)$; or if the pressure between one wire and the junction x is 1,000 volts, the pressure between any two wires is $\sqrt{3}$ times as great or 1,730 volts. If a 3 phase armature be connected mesh fashion then the voltage between any two wires is simply the voltage of a coil. Diagram No. 10.

Consequently in wiring transmission circuits we want to know how the coils are connected. The amounts of current in the lines are calculated similarly, and the general result arrived at is that when the E M F's between lines are equal, the current is greater than that due solely to the coils; while the currents in lines and coils are the same; while in the mesh winding the currents in the line wires are greater than the currents in the coils, but the E M F's are the same. Of course these increased E M F's and currents must have their effect on the size of the wires used (transformer polyphase E M F's), and not to go into the mathematical investigation of this matter, which can be found in papers by Steinmetz, Thompson, Weaver and others, we can summarize the results as follows, comparing the amounts of copper required by various systems, to transmit same power, at same voltage and same virtual voltage, referring them to the standard of single phase alternating unit:

Single phase	100 per cent.
Two phase 4 wires	100 "
Three phase 3 " (mesh)	72.8 "
Three phase 3 " (star)	75 "

Having now seen the necessity for a revolving field; having examined into how to produce it; and having also investigated the peculiar E M F consequent of its use, we may reasonably turn to the consideration of what we can do with it. Briefly, we can make use of the advantages offered by the alternating current system in the transmission and utilization of power, and can transmit any voltage we desire, at any other voltage we desire. We can concentrate a highly efficient steam and electric plant in a factory, village, town or city and send power in every direction in units of any size at a very reasonable cost. We can build our factory right on a railway and load our most magnetic transmission plant transmitted 30 horse power over a distance of 110 miles; and the efficiency of the entire plant was so large as 75 per cent. Thus the advantages of cheap power and of concentration and efficient distribution are rendered available by means of polyphase currents.

It has already been pointed out that a polyphase system is merely the mechanical combination of several single phase alternating systems; and it will therefore be evident that all the conditions inherent in single phase alternating systems will be met with in polyphase working. As the distance and power requirements that caused the evolution of the latter, are in general much more onerous than those imposed on the former, so we find that the reactions attending the use of the alternating current as such, have a much more appreciable influence and require more careful attention in polyphase power work than they do in single phase lighting work. Whereas in alternating lighting plants the reaction and influence of hysteresis, induction, capacity are negligible or comparatively so, when large amounts of power are being transmitted over great distances, they not only become appreciable, but are a very considerable factor in the calculation of the circuits and the size of the generator units.

Hysteresis is a phenomenon attending the magnetization of iron by alternating currents. It is a sort of magnetic friction, and requires power to overcome it. Induction is an E M F generated in a wire by the imposition on it of an alternating E M F and tends to oppose the impressed E M F. It thus requires a higher initial or generator alternating E M F to send a desired current through a circuit possessing inductance than it would be sent through a circuit through a direct current. In such a circuit there is not only the usual Ohmic drop, but also the inductance drop, and as these two sources of drop act, not in the same line but at right angles to each other, the resultant impressed E M F is compounded of the required effective E M F; the resistance E M F, and the inductance E M F.

Capacity is a sort of absorbing quality in the wire which requires to be, so to speak, saturated before it will transmit any current. Its effect is to require a larger amount of current to be generated than would be required if a direct current were being transmitted. The effect of capacity is different in one sense to that of inductance, in that it requires the generation of a greater current instead of a greater E M F, and that it operates in another sense, in that it tends to cause an advance of the current wave in front of the E M F. The combined action of these two quantities is called the reactance of a circuit, and as it generally happens that the inductance is greater than the capacity, there is a "lag" of current behind the E M F. The relative effect of these two quantities is shown in Diagram No. 12. This lag angle has a very important influence on the

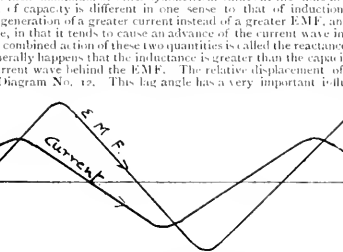


Diagram 12. - Lag of Current Wave Behind E. M. F.

power transmitted. The reactance of a circuit acts at right angles to the resistance, and the E M F required to overcome their combined action is equal to the square root of the sum of their squares, thus total drop = $\sqrt{R^2 + X^2}$ (React X). The total drop is called the impedance of the circuit. The lag angle is found thus:

$$\tan \text{ lag} = \frac{\text{reactance}}{\text{resistance}}$$

Hysteresis may be at once dismissed from further consideration, as, though present in generators, transformers and motors, it does not enter as a factor into transmission, but merely as one of those machine data of which engineers inform themselves when planning an enterprise. It must be said, however, that the expression for the energy lost in hysteresis is $W = K f B^2$.

- Where H = Energy consumed in ergs.
- A = Constant depending on magnetic hardness.
- B = Density of induction in lines per CM.
- N = Frequency of alternations.
- M = Mass of iron in CM³.

Other things being equal it would be advantageous therefore to keep the frequency down and to have the density low.

The expression for the inductive E M F of a circuit is $E = 2 \pi N L I \cos \phi$.

Where L stands for inductance E M F.

2π is the usual symbol.

N stands for our old friend the frequency of alternation.

L stands for the specific inductance of the circuit, and depends on size, length, and mutual distance apart of wires.

C stands for the current in the conductor.

Studying this expression, we observe that the inductive E M F, or E_L , as it will be

called, increases directly with the current, therefore, other things being equal, it is of advantage to lessen the current as much as possible. This is entirely in keeping with the idea of alternating or rent work, as the use of a high voltage permits of small currents to give the same energy transmitted. We observe again that E_L varies directly with the frequency of alternations, so that other things being equal, the use of a low frequency is of distinct advantage as tending to keep down the inductive E M F. (This last deduction, it must be observed, applies to the circuits only.)

The expression for the capacity current of a condenser is $C = 2 \pi N K L \cos \phi$.

Where C = the capacity in farads.

2π is the familiar symbol.

N is again the frequency of alternations.

K is the specific capacity of the condenser.

L is the impressed voltage.

Studying this expression we see that this capacity current is also directly with the frequency, and also with the impressed E M F, and that it is of the same order as the cross section of the wires and their distances apart decreasing as the wires become smaller, and as they are placed further away from each other.

Placing the three expressions for these quantities together:

$$E_L = 2 \pi N L I \cos \phi$$

$$C = 2 \pi N K L \cos \phi$$

We observe that the symbol "N" standing for frequency of alternation is a prominent factor in all, and that the amount of hysteresis loss and inductive E M F, and of capacity current; all of them become greater as the frequency increases. From (2) we see that to transmit a certain amount of energy we must lessen the current as much as possible in order to reduce the inductive drop, and therefore use as high an initial E M F as possible. But from (1) we see that precisely the reverse relation of E M F and current should obtain if we wish to reduce the capacity current to a minimum. In this as in all other cases, a balance must be sought for, and commercial considerations must be taken into account.

I wish to draw your particular attention to a few moments to the retardation of the current behind the electro-motive force, brought about by the induction of line or apparatus, as it has a most important bearing on the transmission of power. The power or energy of a circuit is, as we know, the product of the amperes into the volts; but it is observed that the power transmitted is less than the amount calculated by multiplying the amperes and volts; and it becomes less in proportion as the lag becomes greater. This will be rendered evident by studying the diagram No. 12, where it is seen that the maximum current flow occurs when the E M F has a previous current, and consequently at no time can the power of an alternating current circuit containing induction be equal to the product of the E M F and the current. Quantitatively the power of such a circuit is equal to $C \cdot E \cdot \cos \phi$, where ϕ is the angle of lag. This expression follows directly from a consideration of the diagram connecting generator E M F, reactance and effective E M F, where it is observed that the effective E M F, effective E M F, is the cosine of the lag angle ϕ . The less the reactance, the more nearly does $\cos \phi$ approach unity, and the less is the power lost in the line. The cosine of the lag angle is called the power factor of the circuit, but in figuring the power factor for a particular case, we are to take into account the inductive drop, and not the inductance, but also that due to the self induction of transformers and motors, so that the calculation of the resultant power factor of an entire system, becomes a somewhat complicated matter. It is an absolutely necessary matter, however, because the generator capacity and E M F have got to be larger than the capacity of the motors, by the amount "X secant ϕ ," where X is the amount required of the motors. We first have the line power factor; imposed on that comes that of the transformers, and lastly that of the induction motors; so the resultant power factor is really a quantity to be reckoned with.

In this place it will be apropos to consider that peculiar condition of equilibrium—called resonance—brought about by not allowing sufficient capacity into the line to neutralize the inductance. In this extreme case we shall have no reactance, only the resistance of the line, and the power factor will be unity, and owing to the fact (as pointed out by Steinmetz) that the capacity E M F will be in the same direction as, and therefore additive to the impressed E M F, the resultant E M F will be actually higher than the initial E M F. This addition of E M F's might become a serious matter, as tending to ruin insulation on short lines, but is avoided by this way of line out of balance. To Professor Dudley is due the credit of first pointing out its possibility.

We have now examined the main features of polyphase circuits, and can go on to the consideration of some of the practical questions that arise in the discussion of any transmission system. The first question that arises is, what is the best way to transmit the higher the voltage used, the less the loss, and the less the cost of the line, by various practical considerations. The generator E M F is, of course, limited by the construction of the machine, as to whether or not it permits of more or less insulating material, and the step-up, or raised for transmission purposes to any voltage required by interposing step-up transformers between the line and generator. For any high pressure these transformers are filled with oil, which has a high insulating value, and has the advantage that if a spark does jump at any time, the oil flows back, so that the transformer is not permanently injured. On the flip side a pressure of too low voltage is equally bad, the transformer being run hot, and the insulation surface, and the copper can be bare. At the other end of the line the voltage can either be reduced at once to that required at lamps or motors, or can be reduced first to a convenient distributing voltage—say 1,000 or 2,000—and then be reduced to the lamp or motor voltage. Here, again, the question arises, what is the best way for raising or lowering of voltage introduces an appreciable percentage of loss into the general calculation. For instance, if a large step-up or step-down transformer have an efficiency of 98%, then the loss in a pair is 2%—due solely to C F, leakage, and hysteresis, without taking into account the loss due to the induction of the coils. Another question to be settled is "what frequency E M F shall be used?" and this is one that I do not think requires sufficient consideration. If we look for a moment at the expressions for hysteresis, induction and capacity, we shall see that all these losses are directly as the frequency, and would appear therefore that it would be very advantageous to reduce the frequency as much as possible. The reduction of frequency, however, has the counter-balancing disadvantage that it renders necessary the use of larger, heavier, and therefore more expensive apparatus to carry the same current; and the consequent loss, less than about 1 per cent. per generation per second is appreciable to the eye, in an industrial lamp, and less than about 10 in arc lamps. It is to be used solely for power purposes then this limit is taken away, and the actual decision should be made on the basis of whether the enterprise can better afford to waste power in the lines, or to increase its capitalization.

A subject of such interest as "Electrical Transmission" can hardly receive adequate treatment in the limits of a short paper, and I have already trespassed considerably on your good nature, but I desire to say a few briefly touching on these preliminary considerations which should shape the policy of any enterprise. The engineering features of any enterprise should be not only influenced, but actually decided by commercial considerations. It is not only the object of the enterprise, but the means; the object being to make money by the sale of power. The engineering must be decided by the commercial value of this power. Assume a water power ten miles distant from a manufacturing town, the energy of which is to be electrically transmitted. What loss is to be allowed in the lines? Can we afford to lose a good deal in the lines, transformers, etc., and so reduce the cost of the line? Here again comes the question of cost, and expense? or would it be better to keep the loss as low as possible, and save the power for sale? Engineering says you can make your loss as little or as great as you please, but commercial considerations say if power is more valuable than money it will say to save all the power possible for sale, and not to reduce the loss. If the commercial value of this power is high, and the source of power is limited, it is best to waste as little as possible; if the supply is very large and the demand small, it may, on the contrary, be best to waste much in the lines, in order to reduce the cost of the line. Here again comes the question of cost, and expense? or would it be better to keep the loss as low as possible, and save the power for sale? It is obvious that if much power is to be lost in the line the generators and water-wheels must be sufficiently large to furnish this waste power, and therefore cost more money, and a balance must be struck. Once a decision has been arrived at as to the loss allowed, the engineering considerations are decided, and the engineering must be mostly Ohmic or mostly inductive, and here comes in the question of frequency. The efficiency of machinery is not sufficiently considered, and yet has a most appreciable influence on operating costs. The conditions under which motors operate are generally such that, although they may be called by the name of motors, they are really output now and then, their average load, the work they are required to do most of the time, is greatly less than the above maximum. Consequently it would appear that their efficiency at such average load is of more importance than their maximum load efficiency. If, therefore, in the above case, the supply is limited and the demand

great, the fault of efficiency of the entire plant assumes great importance.

I think the above considerations, and others that will no doubt occur to any thinking person, will show conclusively that no transmission scheme should be undertaken blindly. A should not necessarily use 10,000 volts because it does, nor should he follow the engineering features of E's scheme simply because it has found them suited to his conditions. Every case should be considered on its merits, and the results worked out independently. A little or more or less loss does not mean simply a little less or more copper; it means less or more power to sell, larger or smaller generating plant; it means less or more profit. In every enterprise there is a certain combination of machinery, lines, etc., that will secure the maximum of efficiency with the minimum of expense, and this will not be attained by either regarding it from the purely commercial standard of getting the cheapest, or from the purely engineering standard of putting in the scientifically best, but can only be attained by combining the two and by clearly recognizing the fact that solid commercial principles enter into engineering as much as into pure business.

METERS.

By JAS. MUSE.

The subject of meters is probably the most important one in connection with central station lighting. It has received considerable attention, no doubt, from a few, but I question very much if it has received that attention which it deserves. Every manufacturer, we know, claims to have the best meter on the market,

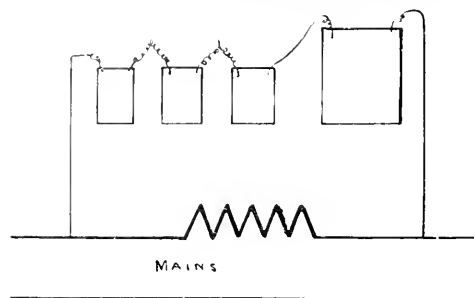


FIG. 1.

correct throughout its entire load. We know also that any manufacturer can quite readily get up a meter to stand a test for a day or so in some laboratory, and be correct, but this, I claim, is of very little use as far as everyday work is concerned. The object of this paper is more to touch on some of the more important meters in practice, making comparison with some of these meters from actual results.

It is sixteen years ago since Edison brought out the incandescent lamp, and we find, according to the records, that even before he had his lamp perfected he was busy on some kind of a meter to accurately determine the consumption of the current. No matter what people say to the contrary, we owe to Edison's inventive genius the practical success of the continuous current. The idea of connecting lamps, motors and other translating devices, in multiple, was original with him; also the high-resistance lamp, the feeder system, and many other important details which tend to make electricity the most useful of all agents. To Edison also remains the credit of originating the meter. He not only saw, as far back as 1880, that there was to be a great future for electricity, but he also saw that to make it a commercial success, as applied to lighting, etc., the current must in some manner be supplied on the meter basis and sold accordingly, just the same as gas or water.

The correct way to sell current is certainly by meter; this is the experience of every one. Satisfactory arrangements can at times be made with certain customers where the average consumption and the average run can be arrived at with a certain degree of accuracy, but even in cases of this kind it is advisable to put on a meter.

Edison's first patent was taken out in 1880, and the meter, with some modifications, is almost identical with the Edison meter of to-day. It is shown in Fig. 1. It consists of several cells in series, and the amount of current passed is measured by the amount of transfer of metal from one plate to another. We see that all the current does not pass through the cells. If the resistances are known of the two branches, we can easily determine the relative amounts of current flowing through each. For instance, if we have a derived circuit, one branch of 1 ohm resistance and the other 2 ohms, we see at a glance that whatever current is flowing in the circuit will divide into three parts, two of which will flow through the one having least resistance, and the remainder through the other. If a copper or zinc voltameter be placed in the 2 ohms branch and we find a certain deposit on one of the plates,

the cathode, then we must know that had there been a similar voltameter in the other branch (1 ohm) there would have been twice the deposit. It is not necessary, however, to put in this second voltameter to arrive at the result, for as long as we know the ratio of the resistances and the electrolytic cell put in any one of the branches, the total current passed through can be accurately arrived at from the deposit in that cell.

One of the laws of electrolysis is that "the amount of chemical action at all points of the circuit are equal to each other." This does not mean that the same current passing for the same length of time through different solutions will decompose equal weights of the metals contained in these solutions, but that the weights of the metals so decomposed will be chemically equal; that is, the weight will be in direct proportion to their chemical equivalent. For those who have not studied the "chemical effect" of the current, it might be advisable to explain some of the terms: The weight of one atom of hydrogen is taken as the unit (1), and that of copper is 63, i.e., 63 times heavier than an atom of hydrogen; but in chemical combinations one atom of copper is worth, or replaces, two atoms hydrogen, hence the weight of copper equivalent to one of hydrogen = $63 \div 2 = 31.5$. This is called the chemical equivalent and is = atomic weight \div valency. The atomic weights of copper, zinc, nickel and silver are 63, 65, 59 and 108 respectively, and their valency 2, 2, 2, and 1 respectively, therefore the chemical equivalents are 31.5, 32.5, 29.5 and 108 respectively. Another term very much used in these calculations is the "electro-chemical equivalent," and this is equal to the weight of a substance in solution decomposed by the passing of one coulomb. If we know the electro-chemical equivalent of any element, and we also know the chemical equivalent of the other metals, the electro-chemical equivalent of these metals can readily be calculated.

It has been determined experimentally that 1 coulomb, passing through water, will liberate .000010352 grams of hydrogen, and as the chemical equivalent of copper is 31.5, therefore the electro-chemical equivalent will be = chem. equiv. \times .000010352 = .000326088, and so on, for the rest of the metals. If we suppose the four cells in Fig. 1 to be copper, zinc, nickel and silver, we have a deposit 117.5 grams in the copper, 121 in the zinc, 110 in the nickel, and 402.5 grams in the silver voltameter, we can determine the amperes-hours.

Let C = current, y = electro-chemical equivalent, t = time in second and M = mass decomposed, then $C = \frac{M}{y \cdot t}$, or taking the copper voltameter, we have $C = \frac{117.5}{.0003261 \times 1 \text{ hour}} = 100$ amperes flowing for one hour or equivalent thereto. If the current in each

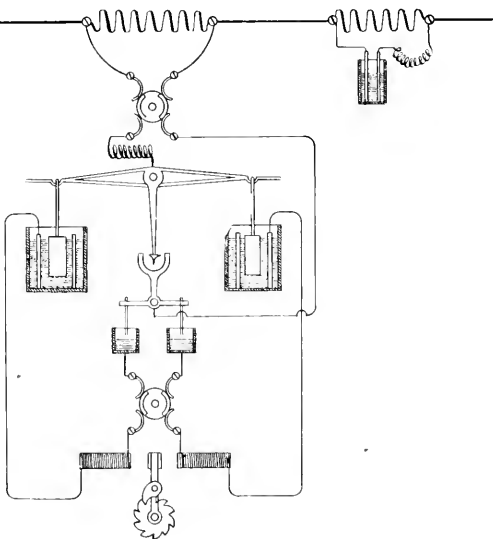


FIGURE 2

of these four cells calculates out to be the same, then we must come to the correct conclusion that 100 amperes must have passed for one hour, or equivalent thereto. If only one of these voltameters had been in the circuit and the resistance remaining the same, we would have had exactly the same results. In the above example of a derived circuit composed of 1 and 2 ohms, we place the copper voltameter in the 2 ohms branch, and we find as above, 117.5 grams deposit, which represents 100 amperes hours; then as this only represents one-third of the total current passed through the circuit, therefore 300 amperes hours would be the correct reading on this particular meter.

With this preliminary and elementary explanation we are now in a position to more clearly understand the chemical meter and

also to follow up some of those as made by Edison. It will, however, be entirely out of the question to treat on all the meters as made by him, so we will simply deal with those having more of a direct bearing on the meter as we have it to-day.

As far back as 1881, it occurred to this genius that in order to satisfy the public, if such a thing were possible, the meter should be arranged that the customer could read it for himself. We therefore find, fifteen years ago, a self-recording chemical meter exhibited at the Paris Exhibition. Its principle is shown on Fig. 2. The resistances are so arranged that only a small known quantity of the total current will pass through the electrolytic cells. The meter as shown would not record, so much like the recording meters of to-day, but if we tilt the balance-beam shown above, this kicks the beam below in the opposite direction, making contact through the mercury cup and sending a current round an electro-magnet, which registers one on the counter. Current now flowing through the cell on the right of the balance-beam was tilted so that the left end was down, and after a certain quantity of current has passed the cathode (the weight on the beam) will get heavier and in time throw the beam the other way. When it is swinging, contact is broken in one mercury cup and made in the other, bringing the electro-magnet on the other side into play, causing another unit to be registered on the counter. The same action takes place in this cell as in the other, and every kick, or second kick, according to the arrangement of the mechanism, is registered on the counter.

In the circuits leading to the cells reversing commutators are placed so that at the end of every month or so the direction of the current can be reversed, thereby reversing the deposit. By this arrangement the plates could be made to last for an indefinite period. In one description I have of this meter it states that the commutating devices were so arranged that when metal was being deposited on one plate the other was being dissolved, or when one plate was getting heavier the other was getting lighter by an equal amount at the same time. Take this style of a meter and we will suppose copper plates in a sulphate of copper solution are used, and that the ratio of resistances are 1309, and we will take it for granted that the beam tells at every .05 grams, and that .04 is registered on the counter. The total deposit is 4700 milligrams, and from this quantity the total current has to be determined. In calculating same out, we find that C in the high resistance amounts to 4 amperes for 1 hour or 4 amp. hours. But this represents only what passed through the circuit in which the voltmeter was placed. $\therefore 4 \times 100 = 400$ amperes for 1 hour would represent the total current passed through the whole circuit when the resistances are arranged as 1309. We might adopt a constant of 4.277 to bring the reading ampere hours.

In this same figure then is one very important detail in connection with same that may be overlooked, yet it shows, to my mind at least, Edison had little faith in this, and I might confidently state, in any other self-recording apparatus. I refer to the electrolytic cell in series with the recording device. I have not the least doubt that this recording meter was as nearly perfect, and probably more so, than the majority of recording meters in use to-day, yet we see that fifteen years ago he came to the correct conclusion that recording devices were unreliable.

It is certainly remarkable when we think over this; we are in precisely the same predicament as we were at that time; we have

meters, are to be seen among his patents; in one the current operated a pointer which made a diagram on a sheet of paper placed on a revolving cylinder, the area of which, when measured by a planimeter gave the consumption. In a meter of this kind the maximum and minimum loads, a very good point indeed, could easily be traced, a thing which cannot be done with any meter we have to-day.

In the early Edison meters copper plates were used which did not give very satisfactory results, and it led the inventor to try various metals, among which was amalgamated zinc immersed in a zinc sulphate solution. This gave excellent results and is used in the meter of to-day with perfect results.

Everyone is aware that the resistance of copper wire increases as the temperature increases and if we wish to keep the resistance of a certain circuit constant irrespective of temperature changes something must be inserted in this circuit which has an equal and opposite effect to that of the copper, that is to say, if we have a circuit of 50 ohms R at 60° Fahr., composed of a spool of wire 40 ohms, and something else of 4 ohms, and if the temperature rises so that the spool now has 47 ohms, then the R of this something else must be 3 ohms if we wish to have the total R constant at 50 ohms. In the Edison meter the resistance of the electrolytic cells decreases as the temperature increases, and to make up for the decrease in resistance a compensating spool of copper wire is put in series with same, which has an increasing resistance equal in amount and opposite to that of the cell. In Fig. 3 it shows the resistance of the "bottle" or electrolytic cell and also that of the compensating spool. We see that the cell decreases and that the spool increases for increased temperature and that the two combined give us practically a straight line. The resistances are calculated from 30° to 110° Fahr. or a range of 80 which is considerably more than is ever met with in practice. In the

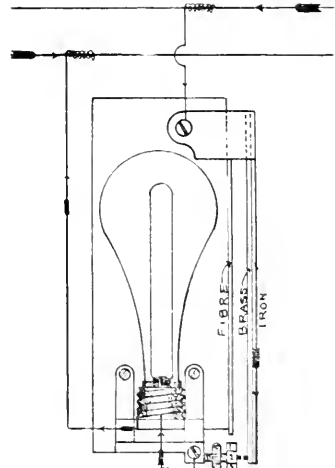


FIG. 3

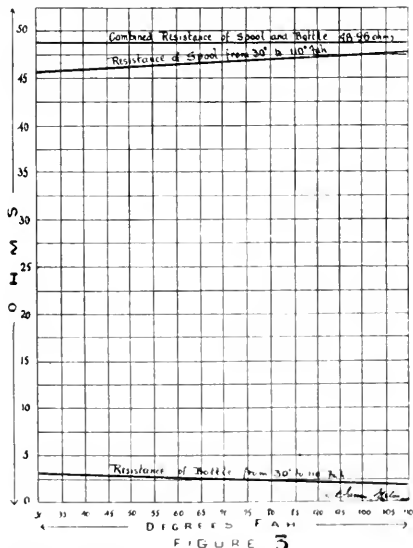


FIGURE 3

Edison meter the branch of low resistance is made of German silver and is called "shunt". The resistance of German silver varies .02 of 1° for every 1° Fahr. In the smallest size of meters the shunt has a resistance of .04 ohms at say 60° and we have no compensating devices, therefore for a rise in temperature we must have an increase in resistance, and if we have an increase in resistance an error must be the result. The greatest percentage of the error will be in the smallest meter, therefore we will just calculate what the error amounts to. At 60° the shunt is .04 ohms, at 105° it is .04040 ohms and at 30° it is .039733 or a difference between 30° and 105° of .000667 ohms making the maximum error that can come into effect less than $\frac{1}{2}$ or to be exact $\frac{1}{2}$ or less than 1 above and less than 1 below.

Taking the conductivities we find that if 100 amperes are flowing in the circuits .08161225 amperes go through the bottle at 60°. At 105° there are .082248 amperes and at 30° .08100 which shows that between 60° and 105° we have less than 1 and between 60° and 30° we have .6° as being the amount of the error.

Where meters are generally located the temperature in the summer rarely exceeds 70°, and in the winter never below 40°. Therefore in actual practice from 25° to 30° degrees would represent the greatest variation of temperature, which gives us .000888 ohms as the R of the shunt at 70° $\frac{1}{2}$ error and .039823 ohms at 40° = .5 error, or in other words the meter in the summer time would be one-fifth of 1° fast, and in the winter about two-fifths of 1° slow, making an average of about one-tenth of 1° slow for the whole year. In the larger sizes this loss decreases to almost nothing. Therefore for the variation in temperature due to the heating of the current or atmospheric variation we see that the percentage of error is practically nothing, so small that it may be entirely neglected.

So far we have assumed the lowest temperature as per Fig. 3 to be 20° Fahr., but there may be places where the temperature goes considerably below this. These places are very exceptional

to do exactly the same thing to-day, viz: put in an Edison chemical meter in series with all these recording coulomb and watt-meters of the motor type if we wish to get at the correct consumption. History does not say whether this type of meter was ever pushed or no, but that is immaterial as the main point I wished to draw your attention to was the cell in series with the recording mechanism. Several other recording devices, including motor

however. The zinc sulphate freezes at 27 Fah. and some means must be taken to prevent its freezing. In Fig. 4 is represented the arrangement as put in the present meter to prevent the solution from freezing. It consists of a strip of brass and steel riveted together and fixed at one end, the other being free to move. It is called the thermostat. When the temperature gets very low the brass contracts more than the steel and causes the strip to curve making contact with the terminals leading to the lamp, which on completing the circuit lights it. When the temperature rises again the compound strip straightens and the circuit is broken.

A patent was filed in 1881 covering this temperature regulator which at that time consisted of a resistance coil acting as the source of heat. Some few months later we find still another method of preventing the solution from freezing. This is shown in Fig. 5. It consists as in the former of the compound strip

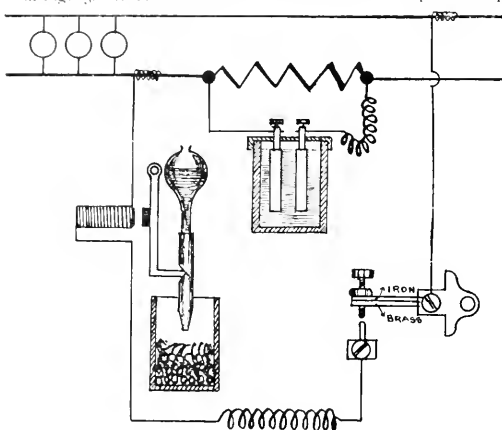
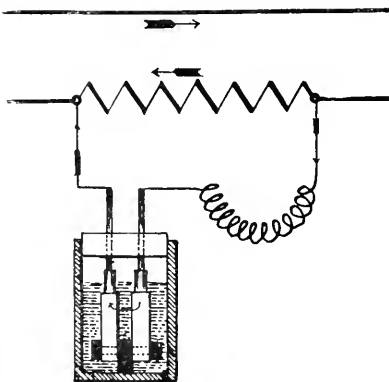


Fig. 5.

which makes and breaks the contact. When contact is made current is sent round the electromagnet, attracting the armature to which is attached an arm operating a valve which when open allows water to run into the cell underneath containing quicklime, the mixture causing heat. I might state that here in Toronto the temperature is so uniform (!) we have no thermostat in any of our meters although they are all adapted for them.

In the next figure is shown diagrammatically the Edison 2 wire

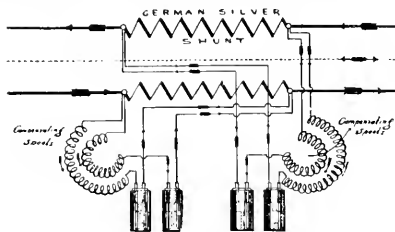


EDISON 2 WIRE METER

Fig 6

meter which, as has already been stated, consists of a German silver shunt in multiple with a compensating spool in series with it the electrolytic cell. The connections, you'll observe, are simplicity simplified. In Fig. 7 is shown a 4 bottle 3 wire meter, and is simply two 2 wire meters in the one box. The object of having the two cells in multiple is that one bottle acts as a check on the other. In a meter of this kind we have practically four 2 wire meters, the two shunts being common to the 4 meters. If we wished to have the same check with 2 wire meters on a 3 wire system of any other, make, there would have to be 4 of these.

In practice we find that the transfer of zinc in each pair of bottles on the same side of a 3 wire system in very many cases agree exactly to a milligram, and the maximum variation never exceeds a few milligrams. This shows without doubt



— EDISON CHEMICAL 3-WIRE METER —

Fig 7

the great accuracy of the meter and when we have a reading on a meter of this kind and the bill sent out accordingly and the customer swears by everything holy that he "never turned the lights on," you are perfectly safe in assuming that if he did not turn them on then some one else did it for him. The customer says one thing and we have two meters silently testifying the other way. Which of the two are you to believe? The meter by all means.

The following table gives the sizes and other particulars of the meters as made to-day.

THREE WIRE.					
Size.	Capacity.	R. of Shunt in ohms.	R. of spool at 60.	R. of bottle.	Capacity in .5 amp. lamjs.
1	10	.04	46.46	2.5	40
2	20	.02	46.46	2.5	80
4	40	.01	46.46	2.5	100
8	80	.005	46.46	2.5	320

TWO WIRE.					
Size.	Capacity.	R. of Shunt in ohms.	R. of spool at 60.	R. of bottle.	Capacity in .5 amp. lamjs.
1	10	.04	46.46	2.5	20
2	20	.02	46.46	2.5	40
4	40	.01	46.46	2.5	80
8	80	.005	46.46	2.5	100
16	160	.0025	46.46	2.5	320

You'll observe that the R of the shunt varies while that of the spool and bottle remain constant for the different sizes.

It has been found, experimentally, that one ampere passing for one hour will remove from one zinc plate and deposit on another when immersed in a zinc sulphate solution 1.225 grams or in other words, the electro chemical equivalent is .00034 grams. One ampere need not flow to deposit this quantity. 10 amperes for 6 minutes or .25 amperes for 4 hours would give exactly the same result. From this electro-chemical equivalent we can determine what the deposit will be for a certain quantity of current and also from a given deposit the quantity of current passed. For instance, we have a current of 100 amperes passing for 3 hours, what would the deposit be if zinc plates were used? We find it is 367.200 grams = .8 lbs. Here we have taken all the current flowing in the circuit as going through the electrolytic cell, which if it did in practice would give us an enormous consumption of zinc. $Cyt = M = 913.104 \text{ grams or } 2 \text{ lbs per h.p. per hour at } 1 \text{ volt,}$ which gives us the formula $\frac{2}{E} \text{ lbs per h.p. per hour as being the consumption of zinc when } E = \text{E.M.F.}$

In the above table we see the resistances are so proportioned that for every ampere passing for one hour in the smallest size .001 grams will be deposited on the plate, that is the resistances are as .04 : 48.96 or 1 : 1224 which gives us exactly 1 milligram deposit for every ampere hour.

Let us now see how the amount of consumption of zinc for a given term or the quantity of current from a given deposit are computed. We will take the deposit as .1 gram or 100 milligrams. In the smallest size of meter when the resistances are 1 : 1224 we saw that 1 milligram represents 1 amp. hour, and also if the resistance were as 1 to 2448 one milligram would represent 2 ampere hours, and so on up to the largest size of meter when 1 to 10584 is the ratio of the resistance. One milligram = 16 amp. hrs. Therefore for the latter size of meter 100 milligrams would represent 1600 ampere hours. Taking it another way we have a current of 160 amperes flowing through the circuit. What will be the deposit per hour? The resistances are as 1 : 19584, $\frac{1}{19584}$ of 160 amperes will flow through the bottle which gives us .00817 amperes for 1 hour = .00817 \times .00034 \times 1 hour = 10 milligrams. But we say that 160 amperes were flowing, therefore to arrive at the total ampere load this reading will have to be multiplied by 16.

In the table the meters are numbered 1, 2, 4, 8 and 16, and the one we have calculated is No. 16, and we have just determined

that the deposit has to be multiplied by 16 to bring it to the same basis as a No. 1 meter, i.e., 1 milligram = 1 amp. hour, or in other words the meter number is the constant of that meter.

On referring to Fig. 7 we see two bottles in multiple. The average deposit is what is taken in these meters which—total deposit ÷ number of bottles in multiple.

The loss in an Edison meter is very small, in fact so small that it may be neglected.

The joint resistance of the shunt and spool of a No. 1 meter is .039957 ohms, say .04, therefore at full load the loss would be 4 watts and only when meter is in actual operation, that is when current is being used. If this meter were placed on a 120 volt circuit it would mean $\frac{1}{3}$ of 1%, and if placed on a 240 volt circuit $\frac{1}{6}$ of 1%, and $\frac{1}{12}$ of 1% on a 500 volt at full load.

As a matter of fact the meters are never put in so as to run up to their full capacity continuously, so that we can safely reckon at the outside the load as being $\frac{1}{4}$ to $\frac{1}{2}$ their rated capacity, which makes the loss on a 120 volt circuit at $\frac{1}{4}$ load .08 of 1%, and at half load .16 of 1%.

The percentage of loss in all sizes is the same if calculated at the same percentage of load.

It might not be out of place to show the ordinary meter form as used in Toronto, which is suitable for chemical and watt meters, and the method of making up the bill from the meter reading is very simple. In Fig. 8 we see that A. B. Smith's reading from April 30 to May 30 is 473 × 4 milligrams, or 1891 ampere hours, and if the bill is rendered in lamp hours, and if each lamp takes .5 amperes then the deposit × 2 gives the bill in cents if the rate is 1c. per lamp hour, or \$37.84.

Some have imagined that nothing but expert chemists can

maintenance, including all chemicals and the reading of same does not exceed 70c. per meter per year.

THE WATERHOUSE METER.

This is a recording electrolytic meter which was brought out some two or three years ago in England and deserves mention in this class. I have not had practical experience with it, but I am of the opinion that it should give satisfactory results. Its construction is shown in Fig. 9, and in Fig. 10 is shown the connection of same.

Meter No. 16738		THE TORONTO ELECTRIC LIGHT COMPANY Limited		CUSTOMER		
Amperes		TORONTO CANADA				
Voltage						
Constant 4		Name A. B. Smith Esq.		Meter No. 1563		
Size No.		Address 69 Madhorn Avenue		Ledger Folio 498		
Wire 37c						
DATE	April 30		May 30			
	LEFT SIDE	A Cell	48 570 48 358 212	50 764		
		B Cell	50 487 50 277 210	52 395		
			RIGHT SIDE	C Cell	52 365 52 105 260	49 264
D Cell	51 496 51 232 264			48 987		
	Less			946		
	Average Less		473			
Read by						

FIG 8

tions of same. We have here the shunt as in the Edison, also the compensating spool. The mechanical part consists of a method of recording the volumes of gas produced by a small portion of the current used by the customer. Gas is accumulated in the collector and the registering mechanism indicates the number of times this has been filled. The operation is very simple and is as follows: When a certain quantity of gas is accumulated it forces the fluid down the U shaped tube until it comes to the bend, and just as soon as it comes to the bend it immediately starts up the other leg and escapes. It is then filled up with the liquid and descends by gravity for another charge of gas. Pure water is used for refilling the cells every 3 or 4 months. This meter is very easily calibrated and is a coulomb meter, registering in ampere hours.

The two electrolytic meters mentioned are only used for continuous current, but there is one called

THE LOWRIE HALL METER

in which the same principle is used to measure alternating currents. In the secondary circuit a storage cell is placed in series with the electrolytic cell and it is taken for granted that the alternating current does not deposit metal, therefore the transfer from one plate to the other depends on the conductivity of the

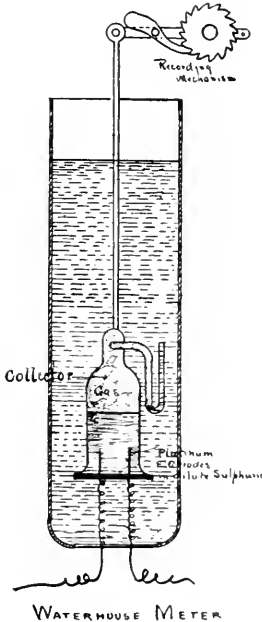


FIG 9

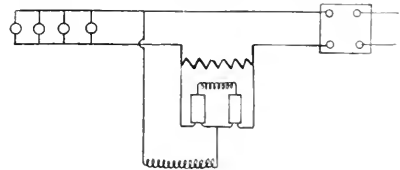


FIG 10

circuit, i.e., the number of lamps turned on. The total current going through the circuit passes through the storage cell, and if no lamps are turned on no current from the accumulator will flow through the voltmeter, and if the lamps are turned on current will flow from the cell to the voltmeter causing deposit, therefore the deposit will be a measure of the conductance from which the lamp hours can be arrived at.

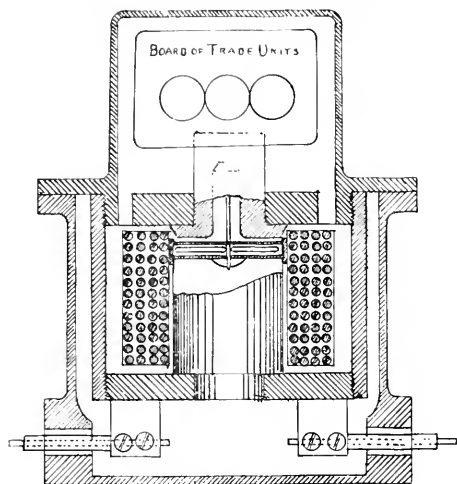
We will now take up motor meters, and in this we have an endless variety. It would simply be out of the question to touch on them all, so we will just take up the most important and treat on them briefly. In this kind of a meter there are a few advantages over those we have already described, but the disadvantages more than offset the advantages. It has been claimed by some that they (some of them at least) require no attention. This is, as far as my experience goes, incorrect, for I find that motor

handle the Edison meter and that its cost of operation and maintenance is high. This is entirely wrong. The meter department of any central station requires at least intelligence and if run without this will very soon become unprofitable and unreliable. In a station where there are about 1500 to 1800 meters the cost of

meters require more attention than any other form, either chemical or clock. Nearly all of them consume energy when not recording, that is when no power is being used by the consumer; none of them will record on very light loads—if they do when just installed, they are not so sensitive afterwards.

There are, however, some very good recording motor meters, if we overlook these disadvantages, among which might be mentioned the Ferranti and Perry in England, the Shallenberger, the Duncan and the Thomson recording meters.

The Ferranti meter is shown in Fig. 11, and is an ampere hour



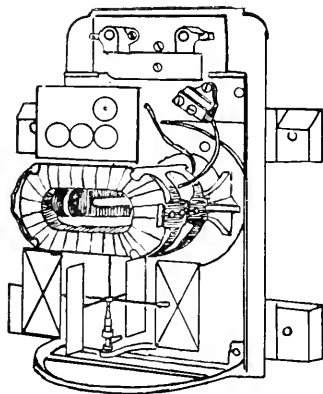
FERRANTI METER

FIG. 11

J. M. L. E.

recorder. If a current is passed through a fluid in a magnet field, this fluid tends to move in a direction perpendicular to the direction of the current and also to that of the field. It is on this principle that this meter depends. Current enters at the centre of the mercury trough and leaves at the rim and in so doing gives motion to the mercury; the motion is communicated to a small aluminum fan which is connected to the recording mechanism. It is adapted for continuous and alternating currents.

In a paper read by a Mr. Dicks before the Institution of Electrical Engineers, a short description of the above and following



SHALLENBERGER METER

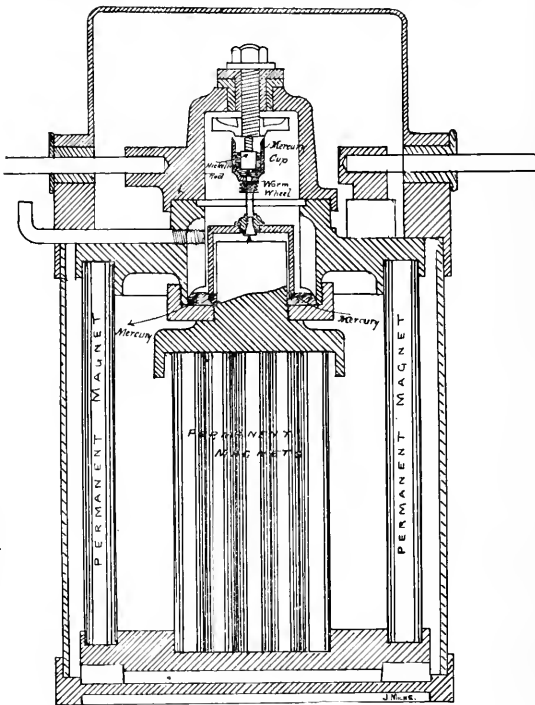
FIG. 13

meter is given which, should any of you wish to follow them up, will prove interesting, I have no doubt.

If current is sent from one end of a cylinder (in a magnet field) to the other the cylinder will rotate, and this is the principle of the Perry meter shown in Fig. 12. Current is admitted to the mercury dish shown at the bottom edge of the inverted copper cup which plows up the sides and leaves by the nickel rod at the top. Friction is reduced to a minimum. The speed of rotation is very slow and the meter will register very small currents in some of the larger meters, say 60 amperes; it will start up with .1 ampere.

The Shallenberger meter is shown in Fig. 13, and is intended for alternating currents. It has been very successful and a large number of them are in use. It consists of two coils, one carrying the main current and the other is a closed coil. A rotary magnet field is produced by an induced current in this closed coil which drags the iron disc around. No brushes or commutator are required; the disc has no electrical connection whatever. The retarding motion is effected by an aluminum fan fixed on the same spindle as the disc. It is an ampere hour recording meter and consequently the speed is directly proportional to the current. The calibration depends on the angle of the closed coil to that of the main coil.

The Duncan meter, of the Fort Wayne Co., has also made a good record, and like the above has neither commutator nor brushes. The armature is an aluminum cylinder and the closed secondary is made of several copper punchings. This meter



PERRY METER

FIG. 12

depends on the repulsion of a closed secondary from its primary. The primary coils are in a series with the lamp circuit. The retarding effect is obtained in the same manner as the Shallenberger.

Probably the most important of all these motor meters is the Thomson recording watt meter.

One of the advantages claimed for this meter is that it is adapted for continuous and alternating currents. This may be an advantage and it may not. In so far as we have meters for alternating currents of a simpler design, it looks to me as if it would be better and cheaper to have the separate meters. This is more a matter of opinion, however. In Fig. 14 is shown diagrammatically the Thomson watt meter. In the armature circuit is placed a high resistance coil, generally placed in the bottom or back of the meter and part in the field, the object of this latter part being to produce a field of sufficient strength to overcome the friction of the moving parts, brushes, &c., and it is perfectly clear that this current must flow whether current is being used by the consumer or not. The copper disc rotating in a permanent field acts as a drag, just the same as the little fan in the former meters, by generating an E.M.F. This E.M.F. is proportional to the speed, therefore the retardation is proportional to the speed and the speed is proportional to $C \times E$; therefore, the speed resulting from this is proportional to $C \times E$, i.e., the power at that particular time.

Regarding the practical working of this meter, let us now devote a little time to same. The conditions in which they are installed are precisely the same as the Edison, that is, they are placed in the basement and as near as possible to the service. Take the average installation and we find very few switches between the service and the meter. The current, as already stated, flows through the armature circuit 24 hours per day, and in a test made recently to determine this amount, it was found that .05 amperes flowed through. This looks a small quantity, but if we have 1200 to 1500 of these meters, it means 60 to 75 amperes to keep up this alone, and from which there is no return.

If the voltage is 120, and taking the cost of manufacture at 2c. per k.w. per hour, it means \$1300 to \$1700 annually, which is equal to 6% on \$22,000 to \$28,000. This represents one source of loss, but there are many more. Every one of these meters, and in fact, nearly all recording meters will when new start with comparatively little current, but after they have been in use for a time a different result is noticed. For instance, we have an installation

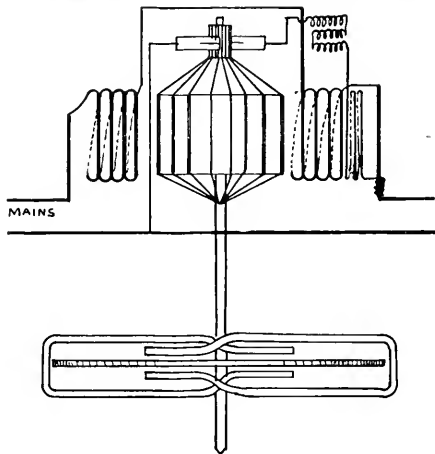


FIG. 14.

of 500 lights on a 3-wire system—or any system for that matter—and we decide to put in a 120 ampere meter. This meter has, according to our Canadian law (God bless it), been duly tested, sealed, etc., and the company is permitted to install same. When first put in it is adjusted as nearly perfect as can be, and it is tried on a very light load. It does not start up with one light, nor two, nor even three; it takes between five and six lights to make it just move. It takes very good eyesight to see it make an attempt to rotate. At half load it appears to be all right, and the same at full load. In a couple or three months, when taking the reading for the second or third time, we try it to ascertain if it is still doing its work. At full and half loads everything indicates that the meter is doing its duty, but at the very light loads we find that instead of registering with 5 to 6 lights as it did at first, it takes almost 12 lamps to make it move. This is not an exaggeration. Although we have taken a large meter, yet I know the percentage is just the same for all the sizes of meters. What does this mean? What does it amount to at the end of the year? Let us take this actual example. Installation of 500 lamps running 2 hours per night for 5 nights per week, and before and after these hours we have from 10 to 20 lights burning three-quarters of an hour each, making a total of three and a half hours for the night.

As stated above it takes 12 lamps to make it record at all, therefore we may assume with perfect safety that the current for at least 8 to 10 lamps, say 8, has no registering effect on the meter. Now these lamps are burning $3\frac{1}{2}$ hours per night, 5 nights per week = 140 hours weekly or 7,280 hours yearly. The total meter reading in this particular installation should be 267,800 hours, but as a matter of fact we only get 260,500 or 95.7% of what it should be, or a dead loss of $4\frac{1}{2}$ per cent., which represents in actual cash, if current is sold at .6 of a cent. per lamp hour as we have it in Toronto of \$43 on this particular meter alone. This may appear to you as being an aggravated case but I must say it is not; it is simply one out of quite a number and we are forced to come to the conclusion that from this cause alone the revenue of a company is 5% less than it should be.

There is yet another source of loss which is not applicable to the small stations. I refer to electric elevator work, or any work where there is a quickly varying load. Elevator work is without doubt the most unsatisfactory kind we have to contend with, and it is acknowledged by every one that these meters, in fact all meters, do not register the energy consumed. Those of you who have observed the action of a wattmeter or any recording meter on these loads must have been reminded of a lazy man, slow to start and quick to stop. In hydraulic elevators the amount of water is the same for all loads and if water is sold by meter or by the "feet run" of the elevator, it costs exactly the same to take up the empty car as it does to take up 4000 lbs. People have been content heretofore to pay for water in this manner and I cannot see why they should not be charged in much the same manner for the electric power. I think I am pretty safe in stating that the motor meter has nearly outlived its usefulness as far as elevator work is concerned.

We see therefore there are 3 great sources of loss.

First. Power consumed in the armature circuit.

Second. Power not recorded at light loads.

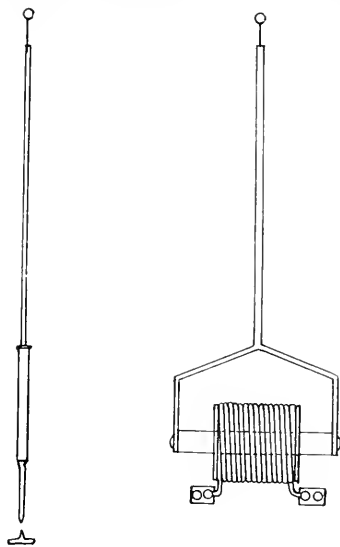
Third. Power not recorded at quickly varying loads.

Now putting all these together we certainly have a very poor combination for any concern to be supplying current by meter measurement.

How do we find the Edison chemical or any other chemical meter under each and all of these conditions. In this meter there are no moving parts, no friction to overcome, no armature circuit, therefore we have practically no loss. The examples I have just given by the motor meter were proved to be incorrect by the chemical meter and as pointed out at the beginning of this paper that Edison did, 15 years ago, exactly

what is being done to-day, viz., he put a chemical meter in series with the recording devices just to see how much the other was out. By actual measurement there is from 20 to 25% difference between the readings in elevator work. I have seen that new meter as got up by the Diamond Electric Co., of Peoria, Ill., which records the energy. In a record of a test sent out by them as made by Professor Jackson at the University of Wisconsin, it is practically correct at all loads and any frequency. As we have already stated these tests are very good in their way, but there is nothing like the test of actual practice and in this alone time decides.

In the next class of meters the Aron figures as being the most important of all clock meters. We have several clock meters in this country but not one of them can in any manner compare with this one. It is adapted for alternating and continuous currents and is made as an ampere-hour or wattmeter. It is one of the most reliable meters in existence. It consists of two clocks, the pendulums of which are shown in Fig. 15—one keeping standard time and the other is retarded or



ARON METER.

FIG. 15

J. M. H.

accelerated as the case may be by the action of a coil or coil carrying the main current in which the "half" of the pendulum consisting of a permanent magnet oscillates. The principle of the gearing from which the motion of the pendulum is communicated to the dial is shown in Fig. 16. When both clocks are going at the same speed the middle

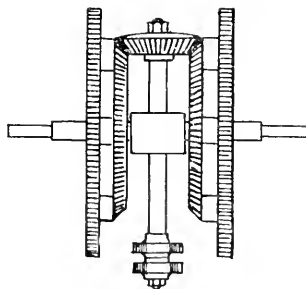
DIFFERENTIAL GEAR
OF THE
ARON METER

FIG. 16

bevel wheel is turned around on its own axis, but if one is going faster than the other the middle wheel is turned around on its axis and also around on the axis of the spur gears. This motion is communicated to the wheels operating the pointers on the dials, and it is only where there is a difference in the speed of the clocks that the meter records. This meter possesses the great advantage of recording, no matter how low small the amount of current is.

In the next figure we show the principle of one of the clock meters

that is used in this country to considerable extent. It is neither an ampere-hour or wattmeter, simply a time recorder, that is, it records the number of hours the current has been flowing in a circuit. It is called the "Pattee Lamp Hour Recorder." It consists of an ordinary clock in which is placed an electromagnet, which is so arranged that when current is turned on a spring is released which disengages the escapement wheel. It is extremely simple and not liable to get out of order. It is very applicable to places where there is a steady power such as arc lamps or motors with steady load. In a store where 10 arcs are required at the one time and the meter records say 200 hours then 200 ×

the specifications contained in schedule on to this Act deposits silver at the rate of .00118 grams per second."

What does this mean? It means that they have practically adopted the chemical meter for determining the unit of current. In the Act it says the electro chemical equivalent is .00118 for a silver voltameter just the same as .00034 represents the grams deposited per coulomb in a zinc or .000305 for a copper voltameter.

It is immaterial whether they specify silver, copper or zinc, the principle is exactly the same, and it does look absurd on the face of it when the unit of current .I.C.G.S. units is according to law laid down as above, yet in the same Act a meter on precisely the same principle is limited to the extent of the number of meters in use at the time the law came into force.

It may be argued that it is not the principle of the meter that is the objectional point but that it is not self recording, the law, of course, calling for "dials." If any consumer wishes to keep a faithful record of the number of hours he burns his lamps he is at perfect liberty to do so and if he does so conscientiously and the lamps of the efficiency they are said to be, or suppose then the bill rendered from the meter reading will coincide exactly to a cent.

Again, it has been claimed by some holding important positions that to be renewing the zincs is practically renewing the meter, that is supplying a new meter. Did you ever hear of such gross rot? What is the law on this point, it is "that the present number must not be increased and all new meters must be of the direct reading type," or words to that effect.

The Government has to raise a revenue, that is settled; the gas companies contribute a certain percentage of that revenue, the electric companies are their greatest competitors, therefore we can readily infer that any little obstacle that can be put in the way by such companies will be done so and it is very common property that this Act was the result of the gas companies.

May I ask "Where did the Government get hold of that definition of the ampere and also the voltameter specification? How are we to determine from this the alternating unit of current?"

Has the Government inspector created any better feeling between the companies and the consumer? Do consumers pay their bills with any better grace than before the law came into force? Do customers put any faith in this test? Are there any advantages to be derived from this test? If so, where?

The answer to the first three is in the negative, and the fourth in the affirmative, and to the last, I will leave it unanswered for the present.

Probably I have digressed from the line of these papers, and in returning to same I wish to again draw your attention to the advantages as enumerated above in the electrolytic meter.

Is there another meter in the market that can lay claim to the same?

OPERATING ENGINES WITHOUT A NATURAL SUPPLY OF CONDENSING WATER, OR THE CONTINUOUS USE OF INJECTION WATER.

By E. J. PHILIP.

THE subject is somewhat new, and information on it must be taken from the few plants that are now operated upon this principle. Like all other new departures in steam engineering, there is very much to be learned and studied before everything in connection with it is properly understood. In a paper of this kind we can only go into the leading points about it, as the subject is so large that a whole volume might be written on it to cover fully the whole ground. From observation throughout the country it is evident that the principle of running engines condensing is not as thoroughly understood as it should be, for we have many cases where there is a sufficient supply of water within reach, and still the engines are exhausting into the atmosphere. This perhaps because many think the expense of putting in and maintaining a condenser is greater than the saving would warrant. As an illustration, take an ordinary high pressure engine of say 100 h.p., using say 4 lbs. of coal per h.p. per hour and running 10 hours per day, the coal consumption would amount to two tons per day. The water consumption per h.p. in that case would be represented by 30 lbs. per h.p. hour. If a condenser is added the same power would only require say 22 lbs. of water, making a saving of 26 per cent. The total coal consumption for the year, running 365 days, would be 730 tons. If the coal can be put in for \$3.00 per ton, the year's consumption would amount to \$2,190. The cost of adding a condenser to such a plant, including the necessary piping, should not exceed \$300. The cost of operating the condenser will be about 6% of the power of the engine, and is equal to \$131. The interest on the condenser investment at 6% is \$18, making a total cost of \$149 per year to maintain and operate it. 26% of the coal account would be \$569, from which deduct \$149, the cost of operation, leaving a net gain of \$420. This in many cases would make a dividend for the owners where there is none at present. In cases where the water for condensation is not procurable except at considerable expense, it can be used over and over again, and be cooled by air. The idea of cooling water in this way originated in Germany, and was applied for the pur-

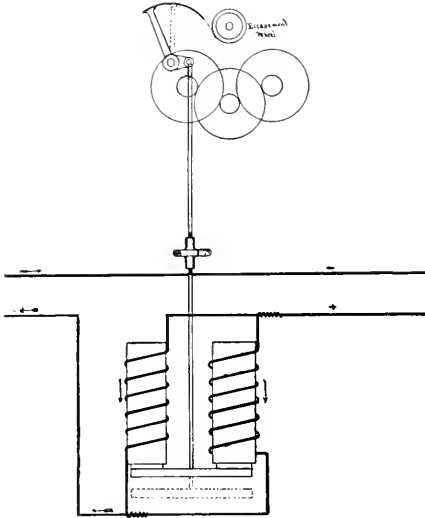


FIG. 17

No. of lamps × rate per lamp hour = bill; or again if we have a motor say 6 h. p. average rate 6 c. per h. p. meter records 100 hours, we have 100 × 6 = \$36.

With this meter, however, it is only an approximation as to the power; however its simplicity commends it.

Let us now sum up the advantages and disadvantages of the various meters.

The advantages of the Edison chemical meter are:

- 1st, Practically no loss.
- 2nd, No moving parts.
- 3rd, Absolutely correct at all loads.
- 4th, Will record the smallest possible amount of current.
- 5th, It is applicable to any pressure.
- 6th, Low first cost.
- 7th, Low cost of maintenance.
- 8th, Readily repaired.

The only disadvantage (if any) is that the consumer can't read it for himself.

MOTOR METERS:—The only advantage is that the consumer can read the meter.

The disadvantages are:

- 1st, Loss in overcoming friction in the moving parts.
- 2nd, Incorrect at light loads.
- 3rd, Incorrect at quickly varying loads.
- 4th, First cost high.
- 5th, Cost of maintenance high.
- 6th, Not readily repaired.

CLOCK METERS:

In the Aron type of meter we have the following advantages:

- 1st, Correct at all loads.
- 2nd, Will record the smallest possible current.
- 3rd, As a coulomb meter it is applicable to any pressure.
- 4th, Practically no loss.
- 5th, Can be read by the customer.

The objections to this meter are:

- 1st, Liability to stop recording if clock stops.
- 2nd, First cost high.

We therefore see as a practical meter the chemical meter is superior in every point, save one, and that is the customer can't read it for himself. Is this much of an objection? How many gas consumers read their meters? I know I am not very far out when I say that not over 2% ever wish to read their meters.

The Edison meter has been condemned by a certain class either through ignorance of its principle or prejudice and our Canadian Government have also seen fit to practically condemn it—probably not condemn it, but to curtail the growth of a meter that has no superior and very few equals.

It does seem strange to me that the Government should interfere the way it has done and more especially with the electrolytic meter when in the "Act respecting the units of electrical measure" in section 14, lines 14 to 21 under the heading of "ampere" it states "as a unit of current the ampere which is .I.C.G.S. units and is represented sufficiently well for practical purposes by the unvarying current which when passed through a solution of nitrate of silver in water and in accordance with

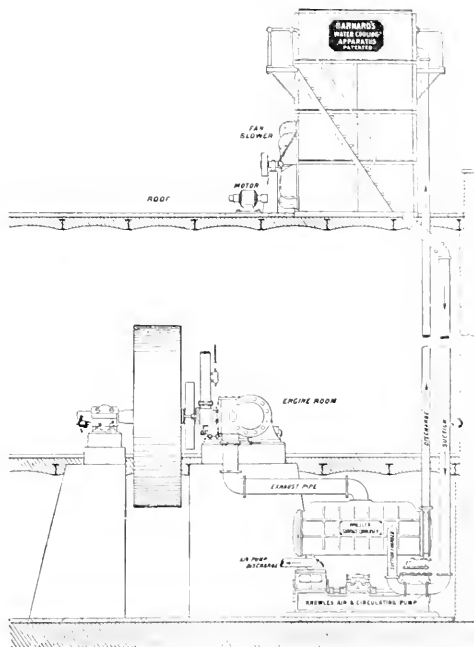
pose of cooling beer. The first cooling tower was filled by the branches of trees, or brush. The air used was only the natural current due to the warm water. This, of course, required a very large tower to get an amount of cooling surface to be effective, as the air current was necessarily very slow. The air is the cooling medium, and is indirectly the condensing medium. If you wet your hand and hold it in a current of air, you will feel a cold sensation, because the water is being evaporated and is taking up the latent heat of evaporation from your hand and the surrounding air. The specific heat of air is .2375, while that of water is unity.

If we depended upon the direct absorption of heat by a rise in temperature of the air, we would have to raise about 4 lbs., or 55 cubic feet, one degree, to absorb a heat unit. Consequently we would have to raise 1,000 cubic feet of air 55 degrees to condense 1 lb. of steam at atmospheric pressure. But when air is brought into direct contact with water, there is a cooling action due to evaporation much greater than is due to the elevation of temperature. When a pound of water is evaporated in this way, five times as much heat disappears as when a pound of water is raised from the freezing to the boiling point, and every pound of water so evaporated absorbs heat enough to condense one pound of steam. Now, by having an arrangement whereby we can pass a strong current of air over a quantity of water, favourably disposed to be acted on by the air current, we can by evaporation of a quantity reduce the temperature, and that is what takes place in a cooling tower, which is an apparatus designed to distribute the water so as to expose a large surface to be acted on by the air. Now, for every pound of water evaporated there is a reduction of temperature which will allow of a pound of steam being condensed, and just bring the remainder to the original temperature. It will be plain, therefore, that in operating a cooling tower there can be no more water used than when running non-condensing. In fact, there is not as much, because there is not as much water evaporated in the tower as there is condensed, as the surface of the tower and pipes have a cooling effect; also, the direct rise in temperature of the air takes away a quantity of heat without evaporating any water.

The engine will require less steam, consequently there is a smaller quantity of feed-water used than when running non-condensing. The system, therefore, allows a plant which has to buy even its feed-water, to run condensing at a less expense for water than when running non-condensing. The details of the system are, at the start, like an ordinary condensing plant. The steam leaves the engine, passing through the condenser, is here condensed by water taken from a small reservoir instead of some natural supply. The water passes to the air pump and is pumped out, forming a vacuum as in an ordinary condensing plant; but now, instead of letting it run to waste, it is elevated to the top of a tower, either by the air pump itself, if the tower is low, or by an auxiliary pump should the tower be high. This is preferable in any case. The water is distributed over the surface of the filling of the tower, falling to the bottom through the up-coming current of air, and the temperature is thereby reduced sufficiently to be discharged into the small reservoir from which the condenser takes its water, and is used over and over again. The details of the tower are:—At the top of the tower is an arrangement to distribute the water over the whole surface of the interior. This distributor has taken many forms, some of which are quite ingenious. Some of the latest are the revolving distributor, illustrated in "Power," for March, and other mechanical papers. This distributor is mounted in the centre of the tank on ball bearings, and the water issues from the cross pipes like the ordinary lawn sprinkler, and distributes the water evenly. Another distributor which is used in towers with what might be termed partition filling, is made with a little trough across the top of each partition, with main channels feeding them. The top of the small troughs are made like a saw on their top edges, and the fine streams of water run through the hollow of the teeth and spread over the surface of the partitions, making a very even distribution. There are numerous other forms, such as perforated plates, screens, etc., all of which will work, but do not distribute as well as the two

mentioned. The filling of the tower or material over which the water is distributed, has taken even more forms than the distributor. From the time when brush was used to the present and latest wire filling, the same idea was at the bottom of every change, namely, to make a given size tower do more work. The cooling effect in a given size tower is a very important point in metropolitan plants, where room is valuable. The first filling was brush. Then round poles were tried. About the same time and at different times since pans have been tried with some success, but was never equal to the tower system. The next was a partition tower, or a board filling. This has taken a great many shapes, the boards being arranged to break up the water and air currents in every conceivable manner. Sheet iron has been tried in various forms, some like stove pipes and others arranged in sheets. The latest and best filling is tile and wire netting.

The tile tower has been described in Power and other mechanical papers. It is very satisfactory. One point against this filling for a large tower is its great weight. The wire or Barnard tower is filled with wire netting rolled up loosely and set up on end. In these towers a settling chamber is provided at the bottom, and a heavy grating is placed across some distance above the water. In this space the fan discharges its air. On top of the grating is placed the tile or wire, whichever filling is used, and it is continued on up as far as it is able to



BARNARD'S PATENT WATER COOLING APPARATUS,
AS ARRANGED ON ROOF OF A BUILDING.

support itself, breaking joints, so as to break up the streams of water. There is a portion of the tower carried on up above the filling, to allow the particles of water to settle out of the air current. This prevents a spray flying from the top of the tower, and also any of the water being wasted. Information on the formula for calculating the size of towers is not very extensively known. As far as can be learned, about 50 square feet of cooling surface is required per h.p., when a large quantity of air is used, say 100 cubic feet of air per h.p., and varies with the amount of air and with the arrangement of the filling. In making up estimates the term h.p. does not give definite information, because the amount of steam used per h.p. varies from 15 to 45 lbs. per h.p. per hour, according to the size and type of engine. The only way is to get the water consumption

of the engine and figure from that, the same as for running condensing. When an engine is using, say 25 lbs. of water per h.p. per hour, it will require about 48 cubic feet of tower for each h.p., with sufficient air and wire filling. With tile filling the cubic capacity required is about 6.5 cubic feet per h.p.

Cooling towers are becoming numerous. We have one in Canada, at Montreal. Two have lately been started at Detroit, and reported as giving excellent satisfaction. The accompanying illustration of Geo. A. Barnard's towers arranged for surface condenser, with the tower on the roof of a high building, will illustrate one application of the system. Further illustrations are not exhibited, because several of the mechanical papers have lately fully shown the different applications of it. It is estimated that the cost of operating a cooling plant is from $2\frac{1}{2}$ to 5% of the power of the engine, which leaves a large net balance in favor of the apparatus, fully justifying its application on plants of any magnitude, or where the cost of coal exceeds \$1.00 per ton. If a tower is placed on the roof a surface condenser should be used, and the ascending column of warm water is balanced by the descending column of cool water, and the actual head the pump works against is the height of the tower. If the tower can be placed in the yard, a jet condenser may be used, unless the object is to get pure water for the boilers. In the beginning of this paper the cost of adding a condenser to a 100 h.p. plant was shown to effect a net saving of \$420, or 20%, nearly. The cost of adding a tower to such a plant should not exceed \$700, the interest on which at 6% is \$42, leaving a net saving of \$378. This would make a very good showing on such a small plant, and would in most cases be much larger. Another point is, in cases where engines are carrying a full load and a little more power is required, attaching a condenser would increase the power about 20%, thereby avoiding buying a new engine, the plant carrying this extra load at the same expense for coal and water.

SOME CENTRAL STATION ECONOMIES.

By P. G. GOSSLER.

On the occasion of an electrical convention a statement of results obtained in the reconstruction of light and power plants will, no doubt, be acceptable, particularly so to station managers who may be confronted with the fact that their plants are not modern, and probably not a paying one, and that the time has arrived when reconstruction is no longer a choice but a necessity.

It is well known that many central stations which have not been operating on a paying basis have been turned into profitable investments by prompt measures having been taken to modernize them, and to put them on a footing to meet competition either from companies already in the field or contemplating entering it. To do this, it has generally been necessary to reconstruct the entire electrical part of the plant from the generators to the lines and transformers, replacing the old generators and transformers by the more efficient apparatus now manufactured; rebuilding and re-designing the switch-board, and last, but certainly not least, the re-arrangement of the feeders and mains, to give economical distribution, to overcome the inductive effects, and to bring the feeder losses within the limits of good practice.

Those who have been so unfortunate as to be in charge of a plant operating generators of small capacity, with a regulation anywhere from 30 to 40%, with drops in the feeders of the circuits varying from 1 to 10%, with no feeder regulators, with the wires so arranged that the worst possible inductive pumping effect is obtained, with a type of transformer whose leakage current is several times what modern practice permits, with a regulation corresponding in percentage to the drops in the feeders, and combined with all this a decided variation in the house wiring drop, will appreciate what a restful feeling is realized, even in the contemplation of a reconstruction that will include new generators and transformers of high efficiency and close regulation, and a safe switch-board. Those who are aware that their service is not what it should be, and who have analyzed the situation, know that the only remedy for the trouble, the only guarantee for a service that will be acceptable to the public and one that can successfully meet competition, is the replacement of any old and inefficient apparatus in use by that which is modern and efficient. This may mean a large outlay, but it should be done at any cost. It may mean the scrapping of old dynamos and transformer—they are of no use to anyone now—what is wanted is only a first-class apparatus. Experience has shown that the first cost of apparatus cannot receive the consideration that it did a few years ago; if it does

there will be within a comparatively short time the same problems to solve.

The following gives results obtained from the partial reconstruction of one plant. It does not give a full idea of what will be accomplished by complete reconstruction inasmuch as that part so far carried out has been confined to transformer and line changes.

The reconstruction planned for the present and now in progress, will affect only the alternating system of a plant which also furnishes direct current arc and motor service. These changes will include the replacing of the present single phase generators and line shafting operating them by two phase generators with an inherent regulation of 4 to 5% without compounding devices, the generators to be belted directly to the engines; the building of the new switch-board for two phase currents serving light and power from the same circuit at 2000 volts; rearranging the lines for two phase distribution; and reducing the station load and bettering the service in general by replacing all of the old transformers on the lines by the best transformers obtainable.

To proceed with a systematic reconstruction, the first things necessary are reliable records, at least of what the plant and lines to be reconstructed consist. For the plant herein referred to it was necessary to establish pole line and circuit maps as well as transformer maps. It may be said that such a system of records in detail and kept up to date is necessary for the economical operating of an electrical lighting station.

For the pole line records a card catalogue was arranged, each card having a number corresponding to a pole; in connection with this card catalogue there is a map on which each pole is located with its number; also, for further convenience in making out reports and locating poles, each pole itself was numbered. The following cut represents a form of pole card which was found to answer the purpose very well.

On the card representing a particular pole all of the wires are shown in their relative positions on the pole by numbers placed over the pins to which the wires are attached, the numbers indicating the circuits of which the wires form a part. By means of this card the positions of the wires forming the different circuits were clearly shown, also what changes in the relative positions of the wires were necessary to overcome existing inductive effects, the latter being a source of much annoyance. In fact, the pumping on the circuits due to mutual induction, prior to their rearrangement, when circuits supported on the same pole were running from dynamos on different engines, was so serious and caused so much fluctuation of the lights that it was necessary to rearrange the relative positions of the feeders of all the circuits to counteract these inductive effects. Very satisfactory results were obtained when the rearrangement of the wires had been carried out. Prior to this change, to overcome fluctuation, it was necessary to feed all circuits on the same pole line from one set of dynamos operated by one engine, which was very often not convenient and only possible with a large loss in operating expenses. If all the circuits on the same pole line were not run from the same set of dynamos, the service was such as to make life a burden for those who were responsible for it. After the rearrangement of the feeders to overcome the pumping, it was possible to run the circuits entirely independent of each other and in a manner most convenient and economical for operating, which is, of course, a source of much economy as well as satisfaction.

In connection with this pole catalogue, circuit maps were arranged, which consisted of diagrams for each circuit, showing the streets upon which the circuit ran, and the size and length of each section of wire or wires.

At the same time these records were being made out, transformer charts were prepared, which consisted of maps for different sections of the city covered by the different circuits. On these maps each transformer was located by a small square stamped on the map, and within this square was written the name of the customer being served from this transformer, the number of lamps installed, the revenue per year, the revenue per lamp per year, the estimated number of hours burned per lamp per day, and the probable number of lamps burning at any one time. There is also indicated on these charts the size and length of secondary wires from the transformer to the customer's cutout. All this information was found necessary for the proper "bunching" of customers on the transformers and for the loading of the transformer.

Wherever possible, secondary systems were established, to which several transformers were connected in parallel, in which case the size of the secondary mains between the transformers was such that the drop in these mains was small compared to the drop in the transformers themselves; in this way the transformers were made to share, more or less, the load equally between them. When a secondary system of distribution was not economical, single transformers were located. In determining whether a customer was to be included in a bunch of customers, all of whom were to be fed from one transformer, or whether it was more economical to place a separate transformer, it was necessary to make an approximate estimate of the cost of locating the transformer for each case. When the interest on the cost of placing a separate transformer plus the cost of maintenance of the transformer, was more than the interest on the cost of connecting a customer to a transformer, feeding other

customers, the connection in question was made to the transformer feeding the "bunch." However, even if the difference in annual cost was small in favor of a separate transformer, connection was made to the "bunch." In making these calculations a fixed drop in the secondary mains was allowed, and the load, i.e., the probable number of lamps burning at any one time, for calculating this drop, was determined from the records on the transformer charts; of course the character of the service goes a great way in making this last determination. A separate transformer was placed only when the total annual cost for the placing and maintenance of such transformer did not exceed the sum of the two following costs—the interest on the cost of placing and maintenance of wire necessary to connect the customer to the nearest "bunch" transformer, and the increased cost due to necessary increase in size of transformer. The annual cost of a transformer on the lines was considered to include the cost of the iron losses, figured as costing the electrical lighting station at an assumed rate of one-tenth (.1 cents) per lamp hour of .55 watts, a .5 interest on the cost of the transformer, and the high rate of charge of 10% depreciation. To facilitate the bunching and loading of transformers in conjunction with other data, the following table:

Capacity in lamps.	Cost of transformers.	Int. on cost at 5%.	Depreciation at 10%.	Leakage.		Cost of leakage at 1 cent per lamp hour, .55 watts.	Total cost of transformers on lines 24 hrs. per year.
				Watts	Watt hours per year.		
10	18.00	.60	1.80	23	254,400	4.62	7.32
15	22.00	1.10	2.20	30	262,100	4.75	8.65
20	26.00	1.30	2.60	33	285,000	5.10	10.00
30	32.00	1.60	3.20	35	306,600	5.48	10.33
40	39.00	1.95	3.90	37	324,000	5.83	11.73
50	47.00	2.35	4.70	54	447,600	8.10	13.12
75	65.00	3.40	6.50	74	599,000	10.33	15.53
100	80.00	4.00	8.00	77	674,000	12.25	16.25
150	112.50	5.64	11.25	85	744,000	13.50	19.33
200	150.00	7.50	15.00	125	1,023,000	18.90	27.40
300	245.00	11.25	24.50	150	1,350,000	23.75	35.75
400	300.00	15.00	30.00	170	1,488,000	26.00	45.00
500	375.00	18.75	37.50	170	1,488,000	27.05	55.30

The principal factor in determining the size of a transformer is the character of the service, a more liberal allowance being made for an overload in a residence than could be made in a commercial district. A good transformer should stand an overload for several hours of at least 25%, and for a shorter period of 50%, or even more.

What has been stated above in regard to the placing and determining the size of transformers assumes of one make of transformers being considered. The subject of selecting a type or make of transformer has been freely discussed elsewhere. It has been shown conclusively from the experience of electric lighting stations everywhere that first cost is no longer the principal factor to be considered in determining what transformer should be chosen to allow of economical operating of a lighting station. Obtain a guaranteed transformer leakage from various manufacturers, substitute these guaranteed leakages for the different sizes of transformers in a table, similar to the one given above, and a comparative statement of the annual cost of different makes of transformers can readily be made from which the most economical type of transformer for the local conditions can be determined. In connection with the above, transformer construction, regulation and efficiency should be considered. It is generally a fact that transformers of small leakage currents have the highest "all day efficiency." With the guaranteed leakage currents there should also be a guaranteed regulation not exceeding 2% or 3%, which is obtainable, for the smaller sizes. The mechanical construction of the transformer is as important as either its efficiency or regulation; the safety of the customers' premises depending upon the protection of the secondary coil from coming in contact with the primary coil, it is necessary that the method of insulating the coils from each other be reliable and absolutely safe. There can be no question that it pays to replace inefficient by efficient transformers. There is but one course to follow if the station be loaded with unnecessary transformer leakage, and that is to replace, at the earliest possible moment, the old transformers by new transformers, using secondary systems where economical, and by this replacement cut down operating expenses and increase the station capacity.

At the beginning of the reconstruction herein referred to there were 1,160 transformers on the lines with approximately 53,000 lamps wired. At the time the following results were collated, there had been 473 old transformers removed from the lines, while 229 new transformers had been put up, leaving a total of 916 transformers on the lines serving about 60,000 lamps. Of these 229 new transformers, 187 had replaced 345 old transformers, while 42 had been used for new customers. Of the 128 old transformers yet to be accounted for, 18 had been removed on account of discontinuation of service, and 110 had been taken from the lines on account of being able to connect the customers served from them to old transformers already erected in their immediate vicinity. This "bunching" of customers on to old transformers was made because new transformers could

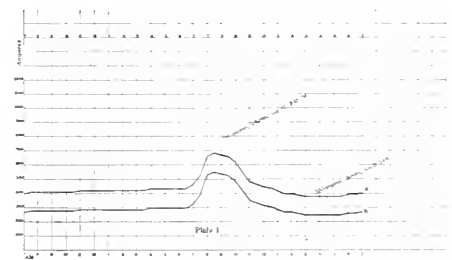
not be obtained at the time and it was necessary to reduce the leakage load before winter.

The lightest load registered during the year preceding the commencement of the reconstruction was 380 amperes. Ten months later, with about 8,000 more lamps wired on the service than at the time of the 380 ampere load, above referred to, the lowest load recorded was 245 amperes, or a decrease in the load line of 135 amperes, this decrease in leakage load being due to the transformer changes just mentioned. The leakage of the 229 new transformers was 10 amperes, which means that the 473 old transformers had a leakage of 154 amperes, or an average leakage of .325 amperes per transformer removed, which figure has been verified by leakage tests made on the old transformers which have been removed from the lines. Thirty-six of the 135 amperes reduction was due to the removal of the 110 old transformers, and placing the customers served from these on other old transformers, making secondary distribution systems. From this is deduced the fact that by replacing the 345 old by 187 new transformers, a saving was effected of 99 amperes. The average saving for the 187 changed is then .520 amperes per change, which with coal at \$2.75 per ton, means an annual saving of \$25.58 per change in coal alone. The average cost of the 187 changes, including the cost of new transformers, all extensions of wiring for secondary mains and all labor, crediting these orders with old transformers as scrap only, was approximately \$65.00. As stated above an annual saving per change in cost of coal would be effected of \$25.58, therefore at this rate the new transformers will pay for themselves, if the saving in coal only is considered, in about two and a half years.

When the 1,160 transformers above referred to have been replaced by new transformers, and the bunching of customers has been carried out, it is estimated there will be but 630 transformers required, and the total leakage will be less than 75 amperes.

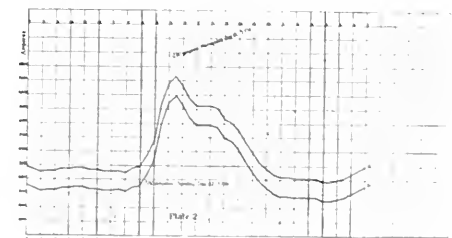
The following curves show three (3) actual station loads; an average load for eight months from June 1st until February 1st, and for the July and December of these eight months, also the estimated loads for the same periods had the reduction in transformer leakage so far actually obtained been accomplished.

Plate 1, Curve A, represents the average load on the



station during the twenty-four hours for seven days, beginning July 10th and ending July 25th, the highest point reached being 700 amperes, and the lowest 380 amperes.

Curve B represents the average load that would have been on the station for the same period had the 917 transformers been on the lines instead of the 1,160, and the saving of 135 amperes been accomplished. As this paper is only dealing with actual results obtained, the curve showing the estimated load on the station for the same period, had this reconstruction been complete, will not be plotted, but it is not hard to imagine what it would have been judging from the results,



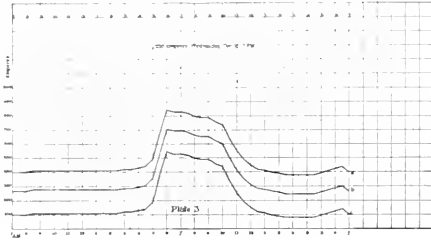
so far obtained, with the transformer changes barely one-third finished.

Plate 2, Curve A, represents the average station load during the twenty-four hours for the seven days, beginning

December 18th and ending December 24th, the highest point reached being 1280 amperes, and the lowest 380, this being the heaviest week of the year.

Curve B represents the estimated station load for the same period, had there been the 917 transformers instead of the 1,160 on the lines. While the third curve showing this estimated load had the transformer changes been complete, has not been plotted, yet it is safe to assume there would have been a difference in the maximum load reached of 300 amperes, so that it would have been necessary to provide station capacity for a maximum load of 980 primary ampere instead of 1280 primary amperes.

Plate 3, Curve A, represents the average primary ampere,



load on the station for the eight months from June 1st to February 1st.

Curve B represents the estimated load during the same period had the reduction in load so far obtained—135 amperes—been accomplished.

Curve C represents the estimated load during the same period, assuming a reduction in primary leakage of 300 amperes.

This reduction in station load with an increased number of lamps wired, due to the decrease of transformer leakage, can be regarded, first, as a saving in coal and operating expenses in general and, secondly, as either an increase in station capacity already installed, which means an increase in the earning capacity of the plant, or a decrease in capacity necessary to be installed to handle the output at time of maximum load.

A decrease in transformer leakage of 135 amperes means a decrease in load of 135 amperes for every hour of operation, which represents a saving in coal, at \$2.75 per ton, of about \$7,348.00 per year, that is for a station running twenty-four hours per day. Apart from this increase in capacity, there is also the saving due to running a smaller engine for the day load, and the consequent saving in labor, oil, etc.

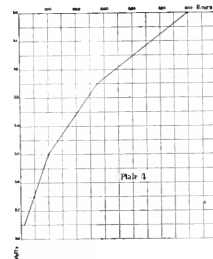
A decrease of 135 amperes leakage means an increase in earning capacity of the station of approximately 270016 CP lamps burning, or about 9,000 lights wired. As so much of the advantage to be gained by this decrease in transformer leakage depends upon the kind of transformer used, it would only seem safe and wise to insist on all transformers coming within guaranteed limits for leakage and regulation. The only way to know that transformers come within the prescribed limits is to get them from manufacturers who are known to build the very best transformer, or better still, test each transformer as it is received from the factory. Inasmuch as transformers made by different manufacturers, and apparently alike in every respect and seemingly identical in construction, are known to vary from twenty-five per cent. to a hundred per cent. from each other, the advisable plan appears to be to test each transformer as it is received. This plan of testing transformers is followed out in many stations and is the only sure means of keeping the leakage within the calculated limits.

The reduction in leakage load so far obtained in the reconstruction under consideration has not been accompanied by any sacrifice of transformer regulation. The type of new transformer used is one giving the best all round results, that is, one in which regulation and leakage are so proportioned in its construction as not to benefit one at the expense of the other. In thickly populated or central business portions of the city, where an extensive secondary distribution is possible, and where large transformers may be connected in parallel at different points, it would be an advantage to use transformers of very small leakage current and high "all day efficiency," as in this case the transformers share the load between them, and regulation can be sacrificed to gain diminished leakage current. However, as it is only in very large cities, and only in the most thickly populated centres of these that the secondary distribution system can be economically used, the make of transformer giving the best all round results should, in general, be selected. To further

improve the regulation beyond that to be obtained by improved transformer regulation it is intended to change the primary distribution from 1000 to 2000 volts, thereby decreasing the copper losses on the existing circuits to one quarter of the present losses, and reducing the feeder drops so that good service and regulation will be obtained without the use of feeder regulators or the erection of additional copper. A source of additional improvement in regulation will be the use of generators with very close regulation. The necessity of transferring the circuits from one dynamo to another makes close inherent regulation in generators an imperative feature if satisfactory service be desired. Transformers with good regulation, feeders having small drops, and generators of close regulation, mean that the ordinary changes of load and transfers of circuits from one generator to another can be made without materially affecting the voltage on the lamps in service. The generators selected for the reconstruction herein spoken of to replace the present single phase generators are of the two phase type and are of such construction mechanically and electrically as to make practically impossible the hairbreadth escapes and the sleepless nights familiar to many operating old style apparatus. The sense of security which takes possession of one after becoming familiar with the type of machine selected can only be appreciated after actual experience in operating. When the reconstruction under consideration has been completed there will have been installed five 300 KW generators, two on one engine, two on a second engine, and one on a third engine. The two generators running from the same engine will be run in parallel when the load requires it, making the units on two of the engines 600 KW, with the advantage of having a more flexible system and a possible saving due to running a 300 KW when a 600 KW would be but partially loaded. The construction and location of the engines was such as to make it impracticable to put 600 KW generators on the two large engines, had it been so desired.

Probably the most economical and certainly the most convenient unit of power for operation is one that has the capacity to carry the day load, the remainder of the dynamos being of a uniform type and size. In the case in question the day load, if the service be confined to lighting would, as stated above, be less than 100 KW, but the adoption of the two phase system will permit of the increase of the day load by the sale of current for motor service, to at least the capacity of the small engine. The small engine, to which is connected the single 300 KW generator, will be run while the day load remains within the limit of capacity of this engine and generator. Should this engine or generator require repairs and it be necessary to run one of the large engines during the day, only one of the 300 KW generators need be excited to carry the day load, introducing a saving not possible if a 600 KW had been placed on this engine, thus giving a higher "all day efficiency" for the two 300 KW generators than could be obtained from one 600 KW generator. The 300 KW units, run either singly or in parallel, are sufficiently large to allow of any desirable arrangement of circuits of ordinary size.

Another factor in increasing the capacity and earning power of a plant is the use of an efficient lamp with an economic



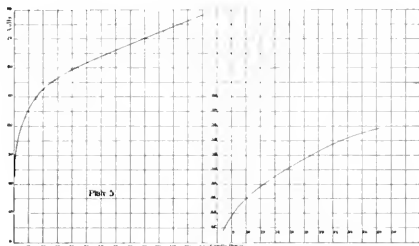
life. The best known makes of lamps on the market have a difference in efficiency of from ten per cent. to fifteen per cent., which means a difference of from ten to fifteen per cent. in the earning power of the plant, depending on the efficiency of the lamp in use. A ten per cent. difference in output or capacity should receive consideration.

Lamps with long life are found to be inefficient; very efficient lamps are usually short lived. There is a point between these extremes which makes a lamp suitable for electric lighting station use. Using an efficient lamp increases the earning capacity of a plant and permits of using higher candle power lamps with a proportionally less increase in cost. An increase in candle power either by high candle power incandescent lamps of high efficiency or small incandescent arc lamps seems to be the best way to meet competition from gas either with the ordinary or the "Auer" burner.

It has been advocated by some, to meet this demand for more light, to running the lamps at a voltage above that for which they are rated, thereby running the lamps at a high efficiency. An examination of the following two Plates, 4 and 5, will show the fallacy of such a makeshift.

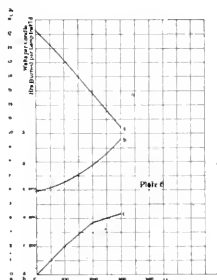
The curve on Plate 4 is the result of many lamp tests, and shows the variation in lamp life for lamps of the same grade when run at different voltages.

Plate 5 shows a curve for the same make of lamp of the



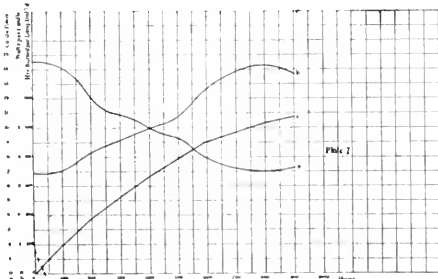
same efficiency, giving the candle power of a lamp at various voltages. As 600 hours is probably the average life of the lamps now on the market, the effect of running this grade of lamp which was rated as a 600 hour lamp, above its rated voltage may be regarded as the effect on the average lamp now offered to the public.

From these curves it will be seen that running a 50 volt lamp at 52 volts, or increasing the voltage four per cent. increases the candle power about nineteen per cent., while the life of the lamp is decreased about forty-three per cent. Running the lamps at a pressure of 55 volts, or a ten per cent. increase of voltage increases the candle power of the lamp about sixty-six per cent., while the life of the lamp is decreased about eighty-three per cent., from which it would seem that to a plant supplying current to a large number of incandescent lamps and furnishing renewals, running them above the rated voltage means a large increase in the lamp renewal account, both for material and labor. Run the lamps as near their rated voltage as possible, and the lamp renewal account will be a minimum. Good regulation on the circuits goes a long way towards keeping this account down. A daily rise in voltage from three to



four per cent. above normal for a short time will reduce the life of a lamp of good economy about one half.

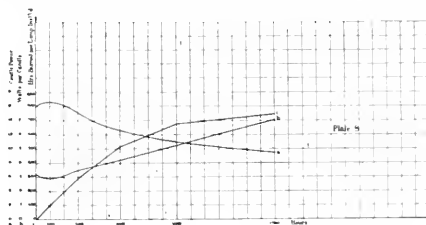
Plates 6 and 7, with their tables, give the results of tests on



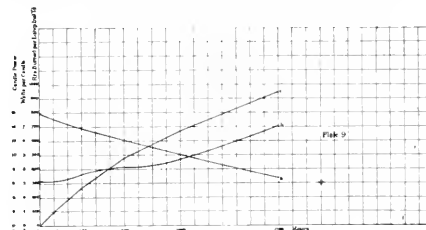
two very well known makes of lamps, when the lamps are run at a voltage ten per cent. higher than their rated voltage.

Curves 8 and 9, with their accompanying tables, give the results of life tests on the same makes of lamps when running at their rated voltages. Plates 6 and 8 are for the same make of lamp. Plates 7 and 9 are for the same make of lamp, but of a different make from the lamp, the curves for which are given on

Plates 6 and 8. The results of these tests are of especial value to electric lighting stations from the fact that throughout the test the conditions under which the lamps were run were made to conform to the conditions imposed upon lamps in commercial service. It has been determined that lamps which have been made by identically the same process differ in lots. It has been



observed that lamps received from the same factory do not average the same candle power and efficiency for different invoices, that is, lamps received in one invoice are generally quite uniform throughout that lot, but they vary considerably from lamps received at other times. From this it will appear that to derive



full benefit from using efficient lamps it is necessary to test the lamps and ascertain that they come within the limits of efficiency which have been decided to be the most economical for the local conditions. To determine what lamp is best suited for any electric lighting station, it is necessary to know the cost of producing current per lamp hour, and having established this for any special make of lamp, the following formula will permit of a comparison of different makes of lamps and the determination of the best lamp for the conditions under which they are to run. In considering the cost of production per lamp hour in connection with the lamp question, the cost of service may be divided into three parts:

A. That portion of the service per lamp hour that is practically not affected by the average efficiency and life of the lamps and such portion of the maintenance, operating and general expenses, as is practically not increased by increasing the current consumption per lamp hour.

B. The cost per lamp hour, coal, water, interest and depreciation on the lines, dynamos, engines, etc., and such part of the expense of the service as increases proportionately to the amount of current served per lamp hour and as the maximum station output.

C. The cost of the lamp per lamp hour, and the expenses per lamp hour for replacing exhausted lamps. This is equal to the cost of one lamp, plus the cost of exchanging one exhausted lamp, divided by the average life of the lamp.

Under the first division (A) should be included the cost of fuses, meters, transformers erected, and secondary connections, line construction, maintenance, etc., and such proportion of the operating and general expenses as is not increased by increasing the current consumption per lamp hour.

Under (B) should be included that portion of the cost of service per lamp hour exclusive of lamp renewals that increases proportionately to the current consumed per lamp hour.

These divisions of cost should be so made that the sum of A, B and C, will represent the total cost of service per lamp hour, the values of A, B and C representing the above divisions of cost having once been established for a lamp of any given efficiency and average life for any particular lighting station the cost of service per lamp hour for this same station with any other lamp which has a current consumption different from the current consumption of the first lamp, and having an average life of "Y" hours, would be $A + NB + C'$ = the cost of service per lamp hour, "X" representing the proportion between the current consumption of the lamps being compared, and "C'" being the cost of one of the new lamps, plus the cost of replacing one exhausted lamp, divided by "Y," the average hours of life of the new lamp.

This formula applies for comparing the cost of producing light with lamps having different costs, efficiency, and average lamp life, when they are to be burned in the same plant and under the same conditions of average lamp hours burned per lamp installed, and the same maximum number of lamps burning for a given number of lamps wired. Value (B) in this formula includes the coal consumption and the materials which practically vary pro-

portionately to the watt hours output required for providing the light. It also includes the interest and depreciation on the plant which must be enlarged when the lamps consume large amounts of current, because the generating and supplying capacity of the plant must be proportionate to the maximum output called for by the lamps. In many plants the interest and depreciation account will form quite a considerable portion of the factor B, and as a large value to the factor "B" makes a showing against the high consumption of current per candle power hour very bad, it would appear that any lamps installed that did not burn at the time of maximum current output from the station could be economically used of a poorer efficiency with longer life than lamps which do burn at time of maximum output, because any additional demand for current on a plant that is not a call for current at the time of maximum output, does not require an increase of plant capacity. In estimating the best efficiency per candle power hour, or per lamp hour, for these lamps that do not burn at the time of maximum output, the cost of interest and depreciation entering into the factor "B" in the formula, in fact all the costs that increase proportionately as the size of the plant required to serve the lights wired) should be excluded from the factor "B." The result is that lamps that do not burn at the time of maximum output can be economically used of considerably lower efficiency than lamps that do burn at that time.

The outline of the reconstruction contained in this paper and the statement of the results so far obtained are for an electric lighting station serving 60,000 incandescent lamps. Another much smaller electric lighting station has had its transformer system rearranged, within the past year, upon the same plans outlined for the station serving 60,000 lamps. This smaller station had, and still has, a capacity of two 500 light dynamos, serving 2,100 lights wired. At the time of heavy load, the station was loaded beyond a safe limit. Apart from this the demand for an increase in the number of lights wired could not be met. An increase in the boiler, engine and dynamo capacity appeared, to some, the only way to meet the requirements; however, this was unnecessary as the transformer system was rearranged, and thereby ample capacity to meet the immediate demands was furnished. Prior to this rearrangement there were 79 transformers on the lines, having a leakage of about twenty amperes. The 79 old were replaced by 42 modern transformers, having a leakage of less than four amperes. By this rearrangement and the substitution of modern for the old transformers, a reduction in load was obtained of sixteen amperes which permits of the station not only carrying safely, with the same station equipment, what was formerly an overload, but also permits of an increase in the earning power of the plant of approximately one thousand 16 candle power lamps.

TABLE C.

Hrs. Burned.	No. of Lamps Burned.	Average Current per Lamp	Average Candle Power per Lamp	Per Cent of Candle Power	Watts per Candle.	Total Lamp Hrs. Burned.	Lamp Hrs. Burned per Lamp Installed.	Average Voltage on Lamps.
0	0	1.14	16.1	100.	3.21	0	0	50.94
100	0	1.06	15.6	103.	2.95	2000	1000	51.3
200	3	1.04	15	63.2	3.49	5767	2884	51.3
300	6	1.05	12.6	78.3	4.17	10374	5187	52.2
1000	16	1.14	11	68.4	5.15	13331.8	666.6	52.
1700	16	1.31	9.5	59.1	7.05	14841.8	742.2	51.8

TABLE D.

0	0	1.03	17.3	100.	7.97	0	100	56.4
100	0	1.00	15.18	88.	3.3	1000	1000	56.2
200	3	1.00	12.8	74	3.9	1638	163.8	55.2
300	6	1.00	10.4	61	4.8	2137	213.7	55.2

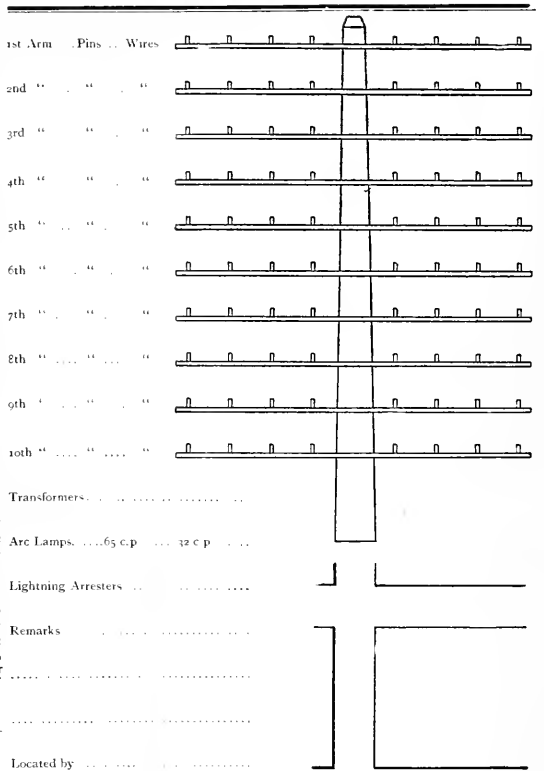
TABLE J.

0	0	1.01	15.6	100	3.16	0	100	50.94
100	1	.95	15.2	95.6	3.5	1954.5	97.8	51.3
200	4	1.03	13.9	87.5	3.48	5369.5	268.5	51.3
300	6	1.02	12.2	77.	4.18	9583.5	479.2	52.2
1000	12	.96	10.1	63.2	4.75	13382.7	669.2	52.
1700	14	.97	6.8	42.8	7.13	18999.8	904.6	51.8

TABLE K.

0	0	1.00	14.5	100	3.16	0	100	56.4
100	6	1.00	14.04	97.	3.56	1000	100	56.2
200	2	1.00	12.	83.	4.15	1866	186.6	55.2
300	3	1.00	10.6	75.2	4.58	2630	263.	55.2
400	3	1.00	9.97	68.8	5.09	3390	339.	55.2
500	4	1.00	9.3	61.2	5.37	3654	365.4	56.
600	5	1.00	7.9	54.5	6.33	4553	455.3	56.
800	8	1.00	7.	48.3	7.14	5157	515.7	56.2
900	8	1.00	7.3	50.4	6.85	5357	535.7	56.5

Location No. St. Ave.
 And Opp. St. Ave. N. E. S. W. Corner.
 Height of Pole
 Kind of Pole For Line City Lamp.
 Condition of Pole



THE OUTLOOK FOR THE ELECTRIC RAILWAY.

By F. C. ARMSTRONG.

It is a significant evidence of the confident spirit with which we have learned to regard the sure and rapid progress of modern electric invention that we accept to-day without comment and as an established practice what was yesterday a matter of tentative and doubtful experiment. This rapidity of achievement has characterized the development of the electric railway, in common with the other great departments of electrical industry, and has already been productive of results of which we can scarcely as yet appreciate the economic and social importance.

Up to within the past year, however, the application of electric motive power for railway purposes has been practically limited to the improvement, amounting to a revolution, of the street railway proper, and an extension of its field as the suburban railway. The work in this direction, though difficult in detail, is necessarily limited in range, and at the present moment may be said to have reached a stage approaching finality. The street railway motor of to-day may be considered, in view of the conditions under which it operates—limited space, exposed position, light weight and severe service, as a highly efficient and satisfactory machine. The controlling apparatus has been developed to an equally high degree of perfection, ensuring in the best types a maximum economy of current, and reduction of strain on the motors under varying conditions of operation, and even adding to its normal function the duties of an electric brake. In the power house, the substitution for the small belt-driven generator, of the large, compact, slow-speed direct-connected unit, with its steel frame and iron-clad armature, leaves little room for improvement in the way of higher efficiency, closer regulation or greater durability. Improvements in design and material have done much to remedy the unsightliness and unreliability of the devices used in overhead construction and the standard pressure of 500 to 600 volts is found, even for suburban extensions of considerable length, to be commensurate with a reasonable copper economy. From a financial point of view the position of the electric street railway is equally assured and satisfactory. No field for legitimate investment is now more favorably considered than that offered by the securities of a well-managed and well-equipped electric railway in a city or town of any size suitable to its capitalization. As evidence of the financial importance to which the electric street railway interests in Canada have attained, may be cited the fact that there are at present in operation, or being constructed in

the Dominion, 36 electric street railways, having a total mileage of close upon 600 miles, using 750 motor cars, with a total generating capacity of 19,500 kilowatts, and representing an actual investment in round figures of over twenty millions of dollars.

At this point, and at a meeting held in the city of Toronto, it is peculiarly fitting by way of contrast and as epitomizing the development of less than one decade, to quote from a catalogue issued nine years ago, in 1887, bearing the title "The Van Depoele System of Electric Railways," in which under the heading "Facts about running the Toronto Electric Railway in 1885," we find the following:

"Plant consisted of one engine, automatic, 10 x 16 cylinder, 150 revolutions per minute; one electric generator, forty horse-power; one electric motor, thirty five horse-power; one motor car, weight six tons; three passenger cars, each two tons. Average number of passengers carried, eighty-three per car; estimated weight of passengers per train, 16 tons; total weight of train, 11 tons; length of track, one mile (with one grade of six per cent.); average speed, 30 miles per hour; passengers carried in 5 days, 50,000; average consumption of coal per day of ten hours, 1200 lbs.; distance travelled in ten hours, including stopping to take on passengers, 200 miles."

The generator in the case, it may be added, was a 40-light arc machine, having, it is stated, "an electromotive force of 1300 volts, and an intensity of current of about 18 amperes," and the single motor, belted to the axle, was a 35-light machine of similar type. In the same catalogue we find a description of each of the Van Depoele roads in operation at the date of its issue. The list is a short one—Montgomery, Alabama, 1½ miles; Detroit, Mich., 1¼ miles; Windsor, Ont., 2 miles; Appleton, Wisconsin, 4½ miles; Port Huron, Michigan, 3 miles; and Scranton, Pennsylvania, 2 miles; a total of 14½ miles. It is amusing to note following this modest list of roads installed, the bold challenge that "As the matter now stands we have more miles of electric railway now in successful operation than all the other electric railways in the world combined."

Coming now to a consideration of the subject of this paper, it is not unreasonable to augur from the success of the electric railway in the past, an outlook for the future equally brilliant and promising. We may leave out of consideration the work which still remains to be done in affording rapid transit for the cities and towns which are as yet either working without street railways altogether, or in which the existing systems are still operated as horse or cable roads. The horse as a propulsive agent for the street car, is steadily pursuing his course to his destined place in the museum, while the cable, in spite of the tremendous inertia of invested capital, is, except in the most congested portions of the larger cities, rapidly giving way before the greater economy of electrical operation. The recent electrical equipment of the extensive Pittsburgh cable systems, involving the abandonment of an investment of many millions of dollars, may be instanced in this connection.

The field for future development in electric traction lies in two distinct directions: in the first place, in the equipment and operation of that recent but now most important factor in transportation—the light or secondary railway, which will in time take form as a network of feeders and channels of distribution for the large centres of population and the great trunk railways; in the second place as the successor of the steam locomotive in the operation of the trunk systems themselves.

It is in the first direction in which already some development has taken place that we may expect the most substantial immediate progress. The possibilities of the light railway have of late been the subject of anxious and careful scrutiny on the part of political economists in England and on the continent generally, as a possible relief for the present acute and world-wide agricultural depression. Without going into the social or economic phases of the question it seems undoubted that from all the large centres of population and production we may expect to see systems of light railway lines radiating to the limits of their spheres of commercial influence and affording at a minimum of cost an adequate means for transportation and interchange of the products of the farm on the one hand, and of the factory on the other.

For such a system requiring a frequent and flexible but not a heavy or high speed service no enormous investment of capital would be required. The use of the public highway would save the otherwise heavy outlay for right of way, and its grade could, for the most part, be conformed to the track and roadbed, even with rails heavy enough for standard freight cars, can, it has been shown, be laid for little more than the cost per mile of a first-class macadamized roadway. The depreciation charges, under normal conditions, would be certainly no greater, and the cost of equipment and operation with electric power, even with the transmission limit of our five hundred volt direct current apparatus, such as to render practicable the working of such systems over a considerable range. We have in Canada several examples of this class of railway, as yet on a limited scale, but in each case affording facilities for transportation, both of passengers and light freight, recognized as being of the utmost value to the public. Each of these roads are, it is encouraging to note, yielding a fair return for the money invested. In the same way the branch lines and feeders of the trunk railways, which are now operated in many cases at a loss, mainly by reason of the inadequate service to which they are limited by the use of the steam locomotive, would, if electrically equipped for a light and frequent service, become a productive part of the system to which they stand at present in the relation of a necessary evil.

It seems, therefore, reasonably clear that in the development of the system of secondary railways which are coming into being as the result of a pressing economic necessity, the electric motor is to find a new and widely extended field of usefulness. The great desideratum at present for this work is a successful alternating railway motor which, it is safe to anticipate, will be added to the list of standard equipment in the very near future. Under present conditions, while the use of the booster or of polyphase transmission apparatus with rotary transformers has made commercially possible the supply of current for distances up to twenty miles, or even more, from the power house, their availability has been lessened by the drawback of excessive loss in the case and of great cost in the other.

Before leaving this part of the subject, however, it would be as well to point out, in view of the alacrity with which the possibilities which we have been discussing are being taken up as a new and promising

field for the exercise of their peculiar abilities by the versatile and talented class of gentlemen known as promoters, that there is no reason to suppose that such a wholesale programme of light railway construction and conversion of existing steam branches would be an immediately profitable or possible undertaking. In many cases the gains made will be in the form of a general public benefit rather than a concrete return in dividends for the money invested. The smaller and more profitable openings for the construction of these lines will afford a field for private enterprise, but any comprehensive scheme will undoubtedly demand in the form of governmental aid, the support of the public, who will be its main beneficiaries.

We may now consider briefly the position likely to be attained by the electric motor as a successor to the steam locomotive in the operation of the great trunk lines. Here the conditions differ materially from those which have led in so short a time to a practically complete possession of the field of street railway traction, and which seem likely to produce similar results in the case of the secondary railways. It must be conceded that no opening or necessity exists for the construction of new trunk lines operated electrically in competition with existing steam roads. The eventual triumph of electricity over steam, for heavy locomotive purposes will come in due course as a result of the establishment of its superiority for the service, but its general adoption will be delayed beyond that point by a natural reluctance to wipe out the capital represented by existing equipment. It must be recognized that the evolution which attends all branches of mechanical development has produced in the steam locomotive of to-day a type admirably adapted to the work which it has so far been called on to perform. It is in the continual demand on the part of the public, for higher and higher speeds between terminal points, and the still more imperative necessity in the face of keen competition and lowering rates for a reduction of operating expenses to the minimum point, that we may expect to find ultimately the most favorable contributing cause for the general adoption of electric motive power on the trunk systems. The direct rotary action of the electric motor and the practical limitation of its power only by the capacity of the stationary source of supply entail the possibility of an increase in rates of speed up to the highest point at which a perfectly constructed roadbed without grades and curves will hold a car on the track. A recent study of the operation of the Pennsylvania Railway would seem to show that such savings in fuel, labor and maintenance accounts would follow its re-equipment for electric traction as to make it commercially desirable, even under present conditions.

It is no extravagant prediction to say that members of this Association who witnessed, in 1885 and '86, at the Toronto Exhibition, the modest beginnings of electric traction in Canada will see it supersede the steam locomotive in the operation of the Canadian Pacific and Grand Trunk Railway systems.

SPARKS.

The employees of the Toronto Street Railway Company held their annual pic-nic a fortnight ago.

Messrs. Folger Bros., of Kingston, Ont., will probably make a bid for the Watertown electric railway, which is now in the hands of a receiver.

The Etna Boiler Company, of Toronto, Ont., is applying for a charter of incorporation. The capital stock is \$20,000, the objects of the company being to manufacture the Etna safety water tube boiler.

The Hamilton Radial Railway Company have closed a contract with an American firm to fit a number of cars with a patent air-brake that will stop a car going at full speed in one car length without injuring the mechanism.

The Canadian Telephone Company, with a capital stock of \$10,000, and headquarters at Sarnyerville, Que., is applying to be incorporated for the construction and working of a telephone system in the county of Compton and other counties in the Province of Quebec.

The large fly-wheel of the engine in the H., G. & B. powerhouse at Stoney Creek burst recently, a piece of the wheel going through the roof, and another portion smashing through the floor. Besides the damage to the wheel and the building, the switch-board was injured. Power was obtained from the Street Railway Company until the H., G. & B. Company got another engine running. About \$3,500 damage was done.

Compared with other large towns, London is easily at the head for the magnitude of its electrical supply. Paris, for instance, has only an equivalent of about 300,000 eight-candle power lamps, as compared with the 1,200,000 lamps in London, as stated above, Manchester and Liverpool have, respectively, about 92,000 and 54,000; Glasgow, 70,000; Edinburgh, 43,000; Dublin, 16,000, and Cardiff, 9,000. Of the total capital expended in the whole of the United Kingdom for supplying electricity, London has spent more than one-half.

The new power house of the Trenton Electric Company at Trenton, Ont., was formally opened a fortnight ago. The building is a large and substantial one, erected on the Trent river a short distance east of the G.T.R. station. The roof and sides are covered with iron sheeting. The water wheels consist of two 150 h.p. vertical turbines, manufactured by the Wm. Hamilton Co., of Peterboro. They are geared directly to a large 6 in. line shaft, which runs the whole length of the building. A convenient arrangement is made by providing each of these wheels with a friction clutch, whereby each may be used independently of the other. The two large generators are 200 h.p. each, bolted direct to two pulleys on the line shaft 8 ft. in diameter. The switch-board, 6 x 7½ ft. in diameter, consists of three polished panels of white marble, on which are mounted the various instruments, switches, regulators, etc., necessary for the controlling of such a large plant.

SPARKS.

W. H. Train, of Burk's Falls, has recently ordered a 500 light increase to his direct current incandescent plant from the Canadian General Electric Co.

The capital stock of the Lachine Rapids Hydraulic Co. has been increased to \$2,000,000. The new stock has all been taken up by the present shareholders of the company.

Thos. Andrews, of Thornbury, is installing a five hundred light alternating plant to furnish incandescent lighting in Thornbury and also in Clarksburg, distant about one mile. The Canadian General Electric Co. are supplying the apparatus.

The Trenton Electric Power Company has been given the contract for lighting the city. The franchise extends for twenty years, and gives them the right to erect poles on the city streets for the purpose of supplying light, power and heat.

Jas. Playfair, of Midland, has closed a contract with the Canadian General Electric Co. for a plant to be installed on the steam barge "Hall." Both arc and incandescent lights will be used; the former for lighting the docks at which the steamer is loading.

D. Knechtel, of Hanover, is extending his monocyclic circuit to Karlsruhe, a distance of three and a half miles, and to Neustadt, a distance of 7½ miles from the power house. This extension is an interesting evidence of the range over which current may be profitably distributed from a modern alternating system.

The report of the General Electric Company of New York for

the fiscal year ending January 31st last, shows the business secured to have been less than 10 per cent. greater in value of sales than for the year previous. The gross earnings were \$13,515,667 and the gross expenditure \$11,910,240. The deficit increased \$877,645. The net loss of liquidation, now charged to the \$2,000,000 special allowance after January 31, 1895, was \$530,152. The company has no notes payable outstanding, nor is any paper bearing the company's endorsement under discount. The report recites the fact of the contract that has been concluded with the Westinghouse Electric and Manufacturing Company. The foreign business of the company has shown a gratifying increase.

The Niagara Falls Electric Light & Power Co. are making extensive additions and changes in their plant, involving an expenditure of over \$25,000. A handsome new power house of pressed brick is in course of erection in a central locality where an ample supply of water can be obtained for condensing. The steam plant will consist of two 200 horse-power compound condensing Wheelock engines. For the incandescent service an order was given to the Canadian General Electric Co. for two 120 kilowatt single-phase alternators. In case a demand for power arises, it is intended to install a 500 volt direct current power generator. The switchboard is to be of white marble, and the instruments and their arrangements are of the most modern design. A system of three wire secondary mains is being installed for distribution through the central part of the town. The work is being carried on under the supervision of Mr. Geo. Foster, the superintendent of the company.

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ELECTRICAL POWER TRANSMISSION TO HAMILTON.

THE Cataract Power Company has been incorporated at Hamilton, with a capital stock of \$90,000, for the purpose of transmitting electric power from DeCew Falls to Hamilton, a distance of 32 miles. The promoters of the company are Hon. J. M. Gibson, James Dixon, John Moodie, John William Sutherland, John Patterson, and Edmund Brown Patterson, all of Hamilton. DeCew Falls are situated about two miles from St. Catharines and receive a constant and unflinching supply of water from Lake Erie. The height of the fall is about 270 feet. The depth of water at the brow of the fall is about 5 inches, and the width about 18 feet. This comparatively small body of water, operating upon water wheels from the height mentioned, is capable of generating 2,500 horse power. The only purpose served at present by this magnificent water power is the operation of a couple of small mills. The Cataract Power Company have acquired the sole ownership of the water privilege, and are understood to have gone very thoroughly into the practicability of the scheme for transmitting the power to Hamilton. No particulars are as yet obtainable regarding the system or methods to be adopted for transmission, but the details are said to have been carefully worked out and submitted to Nikola Tesla and other electrical experts, who have approved of them.

The company have submitted to the Hamilton Street Railway Co., Hamilton and Dundas Railway Co., Hamilton, Grimsby and Beamsville Railway Co., Hamilton Electric Light and Power Co., and other large power users, a proposition to supply them with power at a cost very much below what they are paying under present conditions. The proposition is that the power shall be supplied under guarantee, so that the purchaser is asked to assume no risk whatever. If the company succeed in getting the acceptance of their proposition from the leading power users, the work of installing the necessary plant will be at once proceeded with. The total cost of carrying the enterprise to completion is estimated at nearly a quarter of a million dollars. If carried out this will be the longest electric power transmission line in the Dominion, and one of the longest in the world.

The further development of so important an enterprise, and one which bears to some extent the character of an experiment, will be watched with much interest. The recent declaration of Nikola Tesla that he has solved the means of successfully transmitting electric power for commercial purposes to a distance of 500 miles, augurs well for the success of this and enterprises of like character in the future.

BARRIE ELECTRIC LIGHTING PLANT.

THE picturesque town of Barrie, situated on the shores of Kempenfeldt Bay, is lighted at night by two electric plants.

The steam plant, situated on Bayfield street, was designed by Messrs. Kennedy, McVittie & Co., architects. It acts as an auxiliary to the water plant, which is situated at Midhurst, six miles north.



HON. J. M. GIBSON,
President Cataract Power Company, Hamilton.

The switch board is a substantial slate affair, equipped with Brush instruments. The switch board room is merely a platform raised about ten feet above the floor of the dynamo room. A balcony runs around behind the board, so that the operator can see all of the machines from above. Stairs lead down to the floor of the dynamo room, which is floored in maple. All the machines are set on stone foundations, and the fly wheel of the engine is supported on stone abutments.

The engine is a Brown tandem compound, 186 h. p., with a fly wheel 12 feet in diameter by 24 inches face, driving a 22 inch belt onto a line of shafting, 35 feet long by 4 1/2 inches in diameter. The line of shafting is below the switch board room, and is on a level with the floor of the dynamo room, the pulleys on it working in a pit. From the line of shafting, a 12 inch belt drives a 1000 light Brush alternator with exciter. Three five inch belts drive three Ball arc machines of 25 lights each. The

machines are neat and clean, and everything about the place has a spick and span appearance.

In the boiler room two 14' by 60" Polson 100 h. p. boilers, fed by a Chas. Smith feed pump, and fired by soft wood, generate the steam for the engine. A Polson dependent condenser, direct connected, with a capacity of 300 gallons of water per hour at 90°, beneath the floor of the dynamo room. The brick chimney is a substantial structure of considerable height.

The switch board room, the manager's office, and the cloak room are ceiled with basswood and the floors are maple. The manager's office is neatly fitted up and overlooks the flower garden and well kept lawn. On the switch board are seven switches for incandescent circuits. The board is fully equipped, and the light is sold principally by meter. The dynamo room is lighted by an arc light, and the rest of the building by incandescent lights.

At Midhurst there are two stations, one for arc lighting and one for the alternators. The machines in these plants are duplicates of the Barrie plant. A 30 foot head of water drives the arc plant, and a flume leads down to the incandescent plant.

The company is managed by an efficient board of directors, comprising Jas. T. Burton, President; M. Burton, vice-Pres.; S. A. Seft, Secty.; Jas. A. Sanford, Supt.; L. E. P. Pepler, director.

BY THE WAY.

MR. H. E. EDGE, a prominent lumberman of Sydney, N.S.W., is making a tour of Canada, investigating the merits of the various electrical systems. He expresses surprise at the number of water powers. In Australia, he says, there are but two systems operated by water power, and to obtain the water for one of these a tunnel one mile in length was constructed. The rivers of Australia differ from those of Canada, in that they run for some miles and then disappear for miles. This, he says, is due to the porous nature of the ground in some parts.

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DURING the four or five years of business depression through which we have been passing, all classes have been on the lookout for indications of returning prosperity. As a rule they have seen little of an encouraging character, while with some things have been going from bad to worse. I met a man thus situated recently, to whom I propounded the oft-put question: "What is the business outlook?" The answer I received is worthy of preservation. Said he, "Two or three years ago, you and I were living on our Faith that the times would improve. Last year we thought we could discern signs of promise and we lived on Hope. This year I am living on Charity."

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THE pathway of the sales agent of an electric manufacturing company is not always strewn with roses, judging by an experience which one of them related to me the other day. "You remember," said he, that the city of ——— was lately equipped with an electric street railway. Well, I am the individual who worked that enterprise up from its very foundation, and failed to get either credit or dollars for my labor. First of all I directed my attention to the Council, and after much expenditure of time and the breaking of more than one bottle of wine, secured for the promoters of the road a franchise, which, owing to local prejudices, they could not have obtained for themselves. I next prepared plans and specifications upon which they might invite tenders for the apparatus and construction. Tenders were called, and a meeting of the Council held to consider them, at which I could not be present on account of having to appear as a witness in a suit for the recovery of \$250 misapplied funds. In my absence another representative of our company, who was totally unknown to the aldermen, was delegated to attend the meeting of the Council in the interests of our tender. The result was that the Council accepted the tender of a rival concern, and we were out the profits on a \$30,000 contract, plus time, effort and incidental expenses—the latter of which came out of my own pocket. When, afterwards, I ventured to ask some of the promoters if they did not think I was entitled to a little more consideration, after all I had done in getting them the franchise, etc., they frankly admitted that they had entirely overlooked that feature of the matter, and had simply voted that the lowest tender be accepted, regardless of everything else. If it had not been for that paltry law suit, I would have been certain to have got that contract. The last straw on the camel's back was the fact that the law suit went against us also, and we lost the whole business." Fortunately such extraordinarily "rough" experiences do not strike a man often, but when they do they hit him hard.

As the result of the efforts of a Canadian syndicate the antipathy to the trolley system of street car propulsion in England bids fair to be largely overcome. This syndicate is composed of Mr. Wm. Mackenzie, president of the Toronto Street Railway Company, and Mr. James Ross, manager of the Montreal Street Railway, who have been negotiating for the purchase of the franchise of the existing street railway company of Birmingham, Eng. I met Mr. Mackenzie a few days after his return from Europe, and he informed me that the deal was considered as good as closed. He said: "There is just Mr. Ross and myself in the company as yet. The conditions of the purchase are that we secure an extension of 21 years of the lease of the road, and that the City Council permit the use of the trolley system, but we do not anticipate any difficulty in that line. Of course, the work of electrifying the system will not be commenced until next spring. The road is forty miles in length, and the population of Birmingham, I should say, about three times as large as Toronto." To the question, "Is it your intention to endeavor to secure other franchises?" Mr. Mackenzie remarked that after the Birmingham system was in operation, he thought other cities would soon fall in line. He hoped eventually to secure the adoption of the trolley system in London, where horse cars and busses are now used, and where the prejudice against poles and overhead wires is very strong. "About the best electric railway in England," he said, "is on the Isle of Man; it is eight miles in length, double-tracked, and works very efficiently. In the matter of lighting they are much further advanced, and I had the pleasure of visiting an immense installation at London. As regards electrical machinery, I do not think they are quite as far advanced in Great Britain, and it is just possible that some American machinery will be required for the proposed conversion of the Birmingham road." Mr. Mackenzie purposes making another trip to Europe this fall.

ECONOMIES IN CENTRAL STATION PRACTICE.

A paper on the above subject presented recently before the Chicago Electrical Association by Mr. Thos. C. Grier, concludes as follows:—

There are 'little' economies 'in details.' Here are a few short quotations from letters I received in response to my query as to little economies:

'The first to come to mind under your paper is discount all bills promptly, as your supply house can afford to give better prices when they know their invoices will be paid promptly.'

'If furnishing street lights, show your council and committee that you are trying to give the city all the contract calls for.'

'Treat your customers as reasonably as possible; they will reciprocate.'

'Collect all your bills before the 10th of the month.'

'Keep the stock-room under lock and key and have supplies taken out on requisition; men get careless and this is a leak that foots up very fast.'

'Bad joints, that is, joints not soldered, and loose, is poor economy.'

'The use of exhaust steam for heating in winter is economy.'

Every plant in itself is a distinct problem and what may be economy in one may not answer in another.

OTTAWA LETTER.

(Correspondence of the CANADIAN ELECTRICAL NEWS.)

THE Ottawa Electric Railway Co. have purchased a large parcel of property near the Experimental Farm. Sixteen acres of this is wooded with elm, maples and birch, and is known as the "West End Park." The Somerset street cars furnish a five minute service during the evening, and less frequently during the day. The park was opened on Saturday evening, July 18th, when 4000 people were there. The company have erected an open air theatre, with seating capacity for 1600 people. A commodious stage, with electric foot-lights, a good orchestra and high class performances, fill this enclosure every evening. Edison's late invention, the Vitascope, has been running for three weeks. It requires two currents to operate it. The trolley circuit was used to revolve the films before the aperture and an alternating circuit to project the views on the canvas. The grounds are lighted by numerous arc lights. Five swings and a piano are operated by an ordinary street car motor. The company deserve great praise for supplying pleasant recreation for the warm summer evenings.

Ottawa possesses a large number of electrical firms, of which the following are a portion:

Godard, Garrioch & Co. have been very busy, and have a neat display of electric fixings connected with installations of light or power.

The young firm of O'Reilly & Murphy have in a little over a year built up a satisfactory business. They had as many as fifteen jobs on hand at once this summer.

Chubbuck & Simpson, a new firm, are doing a good business, and have a lot of work on hand.

H. McColl, agent for the Chanteloup Mfg. Co., Montreal, reports business fair.

Mr. Cotter has invented an electric carpet beater. It is a simple little affair, but is a marvel to work.

R. Anderson, general electrician, is installing an electric lighting plant of 75 lights, on the steamer Empress for the O.R.N. Co., and a 25-light plant on J. G. Brigham's ferry wharf.

Ottawa No. 7, C. A. S. E., who have a number of members on the river, hold their election of officers in December instead of May, and their semi-monthly meetings on the 2nd and 4th Fridays. Their last meeting, July 31st, was one of the best they have had. The officers are as follows: President, T. J. Merrill; Vice-President, A. Gaul; Financial Secretary, T. Robert; Recording Secretary, T. G. Johnson; Treasurer, Wm. Hill; Conductor, John Harris; Door-Keeper, J. F. Peters; Trustees, Thos. Wensley, John Cowan, F. G. Johnston. The delegates to the Kingston convention will be T. J. Merrill, F. G. Johnson and F. W. Donaldson.

VERTICAL STEAM BOILERS.

TAKE an ordinary horizontal tubular boiler, one of the kind used in hot water heating plants, with the space inside the shell completely filled with tubes—set it on end, with a furnace below and a chimney connection above, and you have pretty nearly what, for many years, has been the standard type of vertical boiler. And a good serviceable kind of boiler, too, it has been, with all its shortcomings. In cost it was moderate; no special setting was required for it; repairs were easily made, the compactness and a reasonable degree of efficiency were secured with it, so that even to-day it has not outlived its period of usefulness, but continues

in favor and is employed in a wide variety of cases where, all things considered, no other form of boiler will give the same degree of satisfaction.

And yet, for large powers, for high economy, for standard use in high-class power station work, even its distinctly good points could not command its application, except in forms so modified that in many cases little semblance remains to the early upright tubular boiler as we all know it. The designs have been carefully worked over, all with the end in view of turning out something better than the original, and the result is that while the later boilers also are vertical, in the sense, primarily, that they take up more head room than ground space, their tubes are not always vertical nor even approximately vertical, and there is not in every case the conventional shell within which tubes and flues are disposed.

Nor are the tubes always fire tubes, as in the ordinary vertical boiler, for conveying the products of combustion from the furnace to the chimney; frequently in the newer and more complex designs they are water tubes instead and do not always run in straight lines, but often curve and twist in vertical and horizontal planes, in helical paths, in almost all directions imaginable, with the one aim of making them efficient heaters of water, by promoting circulation and absorbing, to the greatest possible extent, the heat of the fuel liberated in the furnace. Albert Spies, in *Cassiers' Magazine* for December.

RECENT CANADIAN PATENTS.

Canadian patents have been granted for the following electrical and steam engineering devices:

Insulating joint—Chicago Gas & Electric Fixture Manufacturing Co., Chicago.

Valve for boilers—John Harrison, Winnipeg, Man.

Electrical indicating mechanism for journal boxes—Wm. b. Chockly, Denver, Col., U. S.

Electric railway—W. B. Purvis and M. M. Armstrong, Philadelphia, U. S.

Filaments and carbons for electric lamps—J. H. D. Willan, 16 Helens Place, London, Eng.

Bonding device for electric railways—Wilson Brown, Camden, U. S.

Electric lamp hanger—Wm. A. Thompson, Toronto, Ont.

Turbine water wheel—John H. Staple, York, Penn., U. S.

Steam boiler furnace—Thomas York, Portsmouth, Ohio, and James E. York, Duluth, U. S.

Turbine water wheel—John B. McCormick, jr., and James Dixon, York, Penn., U. S.

High pressure engine—John Wand, London, Ont.

Appliances for cleaning car tracks—Samuel Irwin and Albert S. Geiger, Waterloo, Ont.

Split switch—Uldarique Gilbeault, St. Isidore Junction, Que.

Force pump—Wm. E. McCall, Peterborough, Ont.

Electric safety appliance for railroads—Edward Levi Orcutt, Somerville, Mass., U. S.

Turbine water wheel—Wm. O. Crocker, Turner's Falls, Mass., U. S.

Electric railway—John F. and John A. Jordan, Brooklyn, N. Y.

Electric railway gate—Herman Biermann, Breslau, Germany.

Machine for raising and lowering electric light—Nelson McLeod, Cannington Ont.

Electric locomotive—J. J. Heilmann, Paris, France.

Balanced steam engine—J. J. Heilmann, Paris, France.

Queen Victoria has had several telephones installed in Windsor Castle. They are placed on her majesty's study table and communicate with Lord Salisbury at the Home Office, Marlborough House and Buckingham Palace. In a few days an electrophone will be introduced at Windsor Castle, and the Queen will be enabled to hear all the latest entertainments in the London theatres and concert halls.

SOLUTION OF ELECTRICAL QUESTIONS.

By the courtesy of Mr. James Milne, we are enabled to present herewith the solution of the questions submitted for the electricity examination of the Toronto Technical School, at the close of the last session :

1. State clearly Ohm's Law. What is the unit of resistance? the unit of current? and the unit of electro-motive force?

ANSWER.—Ohm's Law: The strength of a current varies directly as the E. M. F. and inversely as the R, or the intensity of the current is equal to the E. M. F. divided by the resistance, i.e.,

$$C = \frac{E}{R} : R = \frac{E}{C} : E = CR.$$

The unit of resistance is called the "Ohm" and is equal to 10^9 C. G. S. units of resistance. It is the resistance of a column of pure mercury 1 square millimeter in section and 106 centimetres long at a temperature of 32° F. The unit of current is called the "Ampere" and is 10^9 C. G. S. units. It is that current which will deposit 4.025 grams of silver per hour or decompose .0055944 grams of water per hour. The unit of electro-motive force is called the "Volt" and is equal to 10^9 C. G. S. units, and is also the E. M. F. necessary to send a current of 1 ampere through a resistance of 1 ohm.

2. A battery of 15 cells, arranged five in series and 3 abreast, produces a current of .5 amperes through an external R of 5 ohms. Find the E M F of each cell if its internal R is 3 ohms.

ANSWER.—Let x = Number of cells in series,
 y = " " " in multiple,
 E = E M F of each cell.
 R = External R.
 r = Internal R.

$$C = \frac{E}{R} = \frac{x \cdot E}{\frac{R}{y} + R}$$

$$C \left(\frac{x \cdot r}{y} + R \right) = x \cdot E$$

and substituting all the data given in the question for the above we get

$$.5 \left(\frac{5 \times 3}{3} + 5 \right) = 5 E$$

$$E = 1 \text{ volt.}$$

3. What is the best way of arranging 28 cells, each having an R of 4 ohms, so as to produce the strongest current in a circuit of 28 ohms.

Ans.—In this question the internal R must be = external R,

$$\text{that is } \frac{x \cdot r}{y} = R$$

$$\text{or } \frac{4 \cdot x}{y} = 28$$

$$x = 7 y$$

but the total number of cells = $x \cdot y = 28$, and substituting this value of x , viz.: $7 y$ in the equation, we get

$$7 y^2 = 28$$

$$y = 2$$

Therefore the number of cells in multiple = 2, and as the total number of cells = 28, \therefore the number in series = $\frac{28}{2} = 14$.

4. Compare the resistances of a wire $30'$ long, .06" diameter, and that of another wire $15'$ long and .03" diameter.

ANSWER.—

R_1 = Resistance of one wire. R_2 = Resistance of the other.

l_1 = length of " " l_2 = length " " "

d_1 = diameter of " " d_2 = diam. " " "

$$\text{then } \frac{R_1}{R_2} = \frac{l_1 d_2^2}{l_2 d_1^2} = \frac{30 \times .03^2}{15 \times .06^2} = \frac{1}{2}$$

$$R_1 : R_2 :: 1 : 2$$

5. 1,000 feet of copper wire .102" diameter is wound on an armature of a bipolar generator. Find (1) the total resistance of that wire, and (2) the resistance as measured at the brushes of the machine. One mil foot = 10.4 ohms.

Ans.—In this question the formula is exactly the same as in the preceeding, that is

$$R_1 l_1 d_1^2 = R_2 l_2 d_2^2$$

$$R_1 l_1 d_1^2 = \frac{10.4 \times 1000 \times 1}{1 + 102 + 102}$$

$$= 1 \text{ ohm.}$$

1 ohm represents the total resistance in 1000' of copper wire, and in an armature of a bipolar generator there would be two wires of 500' long in parallel, i. e., we have a derived circuit, each of the branches having $\frac{1}{2}$ ohm resistance each, which gives us $\frac{1}{4}$ ohm as the resistance as measured at the brushes.

6. Take the above question but substitute iron wire. What is the thickness so that the resistance will be the same in each case? The specific resistance of copper to that of iron is as 1 : 6.

Ans.—The cross section will be six times that of the copper,

$$\text{or the diameter} = \sqrt{102^2 \times 6}$$

$$= 250 \text{ mills or } .25''$$

7. Prove that 746 watts make a horse power. Answer this fully.

Ans.—The unit of power is 10^7 ergs per second = 1 watt.

A horse power = 550 ft. pds. per second.

1 foot = 30.479 centimeters.

1 lb. = 453.6 grams.

$$\therefore 30.479 \times 453.6 = 1 \text{ ft. pd.} = 13825.27 \text{ gram. cent.}$$

But a gram = 981 degrees.

$$\therefore 13,825.27 \times 981 = 13,562,600 \text{ ergs,}$$

generally denoted 1,356 $\times 10^7$ ergs per second,

but a h. p. = 550 ft. pds. per second.

$$\therefore 1,356 \times 10^7 \times 550 = \text{ergs per second per h. p.}$$

But 10^7 ergs = 1 watt.

$$\therefore \frac{1,356 \times 10^7 \times 550}{10^7} = 746 \text{ watts per h. p.}$$

8. 1000 feet of wire No. 6 B and S has a resistance of .4 ohms. Find the watts lost in an arc light circuit 5 miles long. Each lamp takes 10 amperes of current.

Ans.—The total R in the circuit =

$$\frac{5 \times 5280 \times .4}{1000} = 10.56 \text{ ohms}$$

$$C^2 R = 10^2 \times 10.56 = 1056 \text{ watts}$$

9. The E M F of a certain dynamo machine is 100 volts, and the total R of the circuit is 1 ohm. What H. P. would have to be expended in working under these conditions.

Ans.—

$$H. P. 746 = C^2 R$$

$$H. P. = \frac{C^2 R}{746} = \frac{C^2 E^2}{746}$$

$$\therefore \frac{100^2}{746 \times 1} = 13.4 \text{ h. p.}$$

10. Distinguish between work and power. What is the unit of each? What is the British heat unit [772 ft. pounds] equivalent to in electrical units of power?

Ans.—Work is the product of a force and the distance through which it acts. The unit of work is the work done in overcoming unit force through unit distance, i. e., in pushing a body through a distance of 1 centimetre against a force of 1 dyne. It is called the "erg." Since the weight of 1 gram = 981 dynes, the work of raising 1 gram 1 centimetre against gravity would be 981 ergs or g ergs. Power is the rate of working, the unit is called the watt = 10^7 ergs per second. If 746 watts = 550 ft. pds., how many watts will 772 ft. pds. be equal to?

$$550 : 772 :: 746 : 1047 \text{ watts, answer.}$$

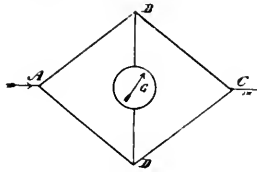
11. Describe fully the Edison chemical meter; knowing that 1 ampere passing for 1 hour between zinc plates immersed in a solution of salt of that metal will remove from one plate and deposit 1125 milligrams on the other. What would be the amount of current that would pass in the above meter if the resistance of the German silver shunt was .02 ohms, and the resistance of the other circuit in which the zinc voltameter of 2.5 ohms is inserted in series with another R of 46.46 ohms, if the deposit was 200 milligrams? Make a sketch of the arrangement.

Ans.—The answer to this question is 400 ampere hours. The Edison chemical meter was fully described and illustrated in the paper on "Meters" read before the Canadian Electrical Association by Mr. James Milne, and which appeared in the July issue of the ELECTRICAL NEWS.

12. Describe the Wheatstone's bridge as fully as you can, and illustrate the application of the instrument by an example.

Ans.—The Wheatstone bridge may be represented by the diagram shown,

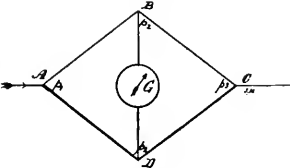
and consists essentially of wires arranged in multiple arc. Suppose current enters at A, it then divides, part going through A B C, and part through A D C, dividing itself into parts that shall be to one another inversely as the resistances in the branches. Since the current is going from A to C the point A must be at a higher potential than the point C and therefore there will be a gradual fall of potential along the branches A B C and A D C. It is therefore possible to find various parts along these branches that will be at the same potential. By altering the resistances in the branches it may be so adjusted that the point B is at the same potential as the point D. When this is so the bridge is in a condition for taking the observation. When B and D are at the same potential there is no E M F between these points and consequently no current will flow in the wire connecting them. The attainment of this condition is indicated by no deflection on the galvanometer G that connects B to D.



Let $AB = \frac{E}{R}$ be the resistance in the arm AB
 $BC = \frac{E}{R}$ be the resistance in the arm BC, and so on.
 We have the following simple relation when the above condition has been satisfied:
 $AB \cdot DC = AD \cdot BC$, and as the resistances in three of the arms are known it is an easy matter to find the fourth. Suppose DC to be the unknown, then

$$DC = \frac{AD \cdot BC}{AB}$$

The following is a proof of the principle of the bridge: Suppose the figure represents the instrument when there is no deflection on the galvanometer, i. e., when no current is passing through B and D, and suppose p to represent the potential at B which would also be the potential at D since no current flows in BD, and let p_2 represent the potential at C.



By Ohm's law we have $C = \frac{E}{R}$; but the E M F in AB is the difference of potential between p and p_2 . C in AB = $\frac{E}{R} = \frac{p_2 - p}{R \text{ of } AB}$ and similarly the current in BC = $\frac{p_2 - p}{R \text{ of } BC}$, but the same current must pass through BC as that passed through AB, since none goes through BD.

$$\therefore \frac{p_2 - p}{AB} = \frac{p_2 - p}{BC} \quad (1)$$

In the same way the current in AD = $\frac{p_2 - p}{AD}$ and it must be equal to $\frac{p_2 - p}{DC}$ that is $\frac{p_2 - p}{AD} = \frac{p_2 - p}{DC} \quad (2)$

and if we divide (1) by (2) we get $\frac{AD}{AB} = \frac{DC}{BC} \therefore AD \cdot BC = AB \cdot DC$.

Numerical example:

$$\begin{aligned} AB &= 100 \text{ ohms} & BC &= 9756 \text{ ohms} \\ AD &= 10 \text{ ohms} & DC &= \text{unknown} \\ DC &= \frac{10 \times 9756}{100} = 975.6 \text{ ohms.} \end{aligned}$$

13. How are very high resistances measured? A galvanometer or 6000 ohms shows a deflection of 10° when a certain resistance is in circuit with it. Knowing that the same galvanometer shows the same deflection with a resistance of 1-10th megohm in circuit when shunted with a 1-99th shunt, find this certain resistance. The resistance of the battery is neglected.

Ans.—As the ordinary bridge is only capable of measuring resistances up to 1,111,100 ohms a different method is adopted for measuring resistances above this, viz.: by the galvanometer.

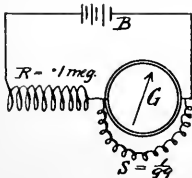


FIG. 1.

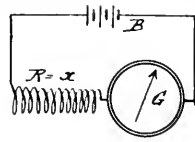


FIG. 2.

Let the first figure indicate the circuit with 1-10th megohm in series

with the shunted galvanometer, and the second figure that of the circuit with the unknown resistance in series with the galvanometer without the shunt. By Ohm's law we have

$$C = \frac{E}{R + \frac{E}{\frac{G \cdot S}{G + S} + B}} = k \cdot d_1 \cdot \frac{G + S}{S}$$

Where $\frac{G \cdot S}{G + S}$ Joint R of Galvanometer and Shunt,

B = Resistance of Battery,

k = a Constant to bring $d_1 \cdot \frac{G + S}{S}$ to Amperes,

d_1 = Deflection of Galvanometer,

$\frac{G + S}{S}$ = Multiplying Power of the Shunt.

In the second figure we have

$$C_2 = \frac{E}{R_1 + R_2 + G_1 + B_1} = k \cdot d_2$$

In the first equation we have

$$E = \left(R + \frac{G \cdot S}{G + S} + B \right) \cdot k \cdot d_1 \cdot \frac{G + S}{S}$$

and in the second equation we have

$$E = (R_1 + G_1 + B_1) \cdot k \cdot d_2$$

$$\therefore (R_1 + G_1 + B_1) \cdot k \cdot d_2 = \left(R + \frac{G \cdot S}{G + S} + B \right) \cdot k \cdot d_1 \cdot \left(\frac{G + S}{S} \right)$$

Substituting the numbers in the question and omitting the resistance of the battery and cancelling k, we have

$$(R_1 + G_1) d_2 = \left(R + \frac{G \cdot S}{G + S} \right) d_1 \cdot \frac{G + S}{S}$$

$$(R_1 + 6000) d_2 = \left(100000 + \frac{6000 \cdot 60.6}{6000 + 60.6} \right) d_1 \cdot \frac{6000 + 60.6}{60.6}$$

and as $d_1 = d_2$, we get

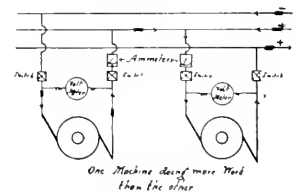
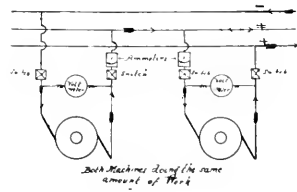
$$R_1 + 6000 = (100000 + 60) \cdot 100$$

$$R_1 = 10,000,000.$$

Therefore, the resistance of R or x is 10 megohms.

14. Show by a diagram the general arrangement and connections of generators running on a 3-wire system. Show by an arrow the direction of the currents if (1) both machines are doing exactly the same amount of work; (2) if one machine is doing more than the other. Place in position ampere and voltmeter.

ANSWER.—



15. 880,000 lines of force (N) are to be forced through a bar 20 in. long and 8 sq. inches in area. Find the reluctance and the magnetizing force in ampere turns to effect this magnetization. Permeability = 166.

$$\text{Ans. Reluctance} = \frac{\text{length}}{\text{area} \times \mu} = \frac{20}{8 \times 166} = \frac{1}{66.4}$$

$$\text{Ampere turns} = N \times \text{reluctance} \times .3132$$

$$= 880000 \times \frac{1}{66.4} \times .3132$$

$$= 880000 \times \frac{1}{66.4} \times .3132 = 4150$$

16. In a generator which is driven by a 100 H.P. engine, belt speed 5,000 ft per minute, there are 200 conductors in the armature winding 100 sections in commutator, the gap is 45°. Find the torque and the drag on the active conductors.

Ans.—100 h.p. = 5000' × torque

$$\text{Torque} = \frac{100 \times 33000}{5000} \times .3132$$

$$= 660 \text{ lbs.}$$

The active conductors = $\frac{270}{360}$ of 200 = 150 $\therefore \frac{660}{150} = 4.4$ lbs. drag on each conductor.

HEAT IN CYLINDER WALLS.

THERE was made recently at Sibley College an interesting study of the loss of heat from the cylinder walls of an engine during each stroke. The object was to determine the varying temperature of the cylinder head during the stroke. Steam on entering the cylinder warms up the surfaces and a certain amount of heat is stored in the cylinder walls; when the exhaust opens the temperature falls and heat flows from the walls and is lost. To determine this, experiments were made with a 10 h. p. slide-valve engine, cutting off at about half stroke. The plan of investigation was as follows: A wire of small cross-section and high electrical resistance was placed on the inner face of the cylinder head, and connected in multiple with a constant current supply and a delicate galvanometer. As the temperature varies with each cycle of the engine, the electrical resistance of the wire rises and falls with it, the amount of current flowing being altered, and a corresponding deflection being thus obtained in the galvanometer. To preserve a permanent record of these pulsations, the galvanometer was of the mirror type, so that its deflections could be recorded on a sensitive photographic plate.

This galvanometer is of special interest. It consists of a minute needle and mirror, mounted with a short suspension, and surrounded by a coil of fine wire, placed in a powerful magnetic field. This instrument possesses a great sensitiveness, and since its vibrating parts are of such delicate proportions, can be relied upon to give accurate results. The field produced by the coil is at right angles to the permanent field, and the galvanometer being acted upon by these two forces, takes up a resultant position, and follows this resultant with unerring accuracy, regardless of the rapidity of the current changes in the coil.

The high shunt resistance on the engine head consists of 27" of No. 30 iron wire stretched back and forth over a sheet of mica and held in place by heavy mica strips clamped over the ends; the whole being held in place by a frame of fiber-board securely bolted to the head. This construction allows the wire to be well insulated electrically, yet exposed to the live steam.

To obtain a constant current supply, a storage battery of high potential was used, with a large resistance in series, giving a current of about .8 ampere.

As the galvanometer and resistance in the engine head were in multiple with this battery, and the change of resistance due to heating in the head was slight in comparison with the resistance in series with the storage cells, the current remained perfectly constant, and a common error in this method of operation was thus eliminated. An arc lamp, especially constructed for the purpose, furnished the light for the mirror of the galvanometer.

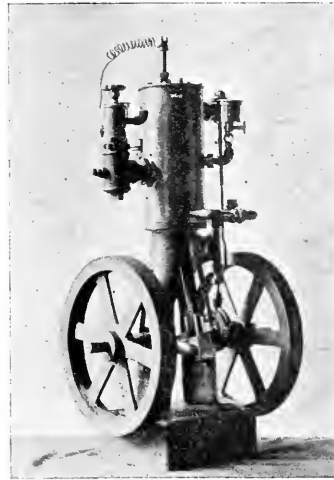
The reflected ray was moved along a slit, behind which a photographic plate was carried up and down by the indicator reducing motion.

The diagram obtained with this heat indicator was almost exactly like the regular indicator diagram in appearance, its lines representing temperatures instead of pressures. The diagrams were taken at various pressures and speeds, and all showed the same characteristics—a nearly constant temperature from admission to cut-off, a slight drop beyond this point, a sudden fall at release, and a continual fall on the return stroke until compression occurred, when there was a marked rise in temperature.

Another experiment was also made to determine how deep in the cylinder head the temperature varied. It was found that at a depth of beyond .05 of an inch the temperature of the head did not vary, but remained constant some 30° lower than the temperature of the steam at initial pressure. As the depth was decreased the temperature varied with the steam, and the cards again showed the same resemblance to the first experiments. From this investigation it is evident that the depth of metal affected to cause the phenomena of cylinder condensation is very slight; that the heat cycle in the iron follows the indicator diagram very closely; and that the average temperature at the point where variation ceases is quite near the temperature of the steam.

NEW GASOLINE MOTOR.

THE accompanying illustration shows a gasoline motor of new design built by Mr. Thomas Reid, of Hamilton. The engine has an open base, the charge of gasoline being drawn directly into the cylinder, where it is ignited by an electric spark. It has an impulse at every revolution, but can at will be closed down so as to have an



impulse every second or third revolution, as desired. The engine is built in two styles, vertical and horizontal, the vertical being preferable for boats and the horizontal for carriages or power purposes. One of these motors has been at work in the maker's premises for some months past, and is said to give entire satisfaction. It is the first motor of the kind to be made in Hamilton.

When an injector fails to work, ascertain if the pipe to the boiler is free and clear, for it may have become partially filled with sediment, thus causing all the trouble.

A contemporary prints the following as a simple method of demagnetization: A strong magnet is placed in a horizontal position—on a table, for instance—and the watch held horizontally about half a yard off on a level with the magnet. The watch must then be brought slowly nearer the magnet, while being turned slowly, and at the same time as regularly as possible, between the fingers, as on a vertical axis. When the poles of the magnets are reached, the turning of the watch is to be continued while being gradually withdrawn until the starting point is reached.

ELECTRIC COAL MINING PLANT.

A MOST interesting matter in connection with a visit to the underground workings of the new Vancouver Coal Company's mine at Nanaimo, B. C., is the electric plant in operation there. It has been in operation for four years now and has worked smoothly from the first, and given perfect satisfaction. It has quite superseded mule haulage over the underground trunk roads, but for branch roads mules are still employed.

The engine used for generating the electricity is the well-known Eric Ball high speed type, 16-inch cylinder by 16½-inch stroke, automatic cut-off, centre crank, double fly wheel, and is run at a speed of 235 revolutions per minute. Its rated h. p. is 150, although the work is being done with an expenditure of 90 h. p. It is bedded on a foundation of concrete, brick and stone, immediately resting on two large blocks of dressed sandstone, which keep it perfectly firm and rigid.

Two boilers are used for supplying power. External fire, Lancaster pattern, 24 feet in length by 4 feet 6 inches in diameter, and carrying a pressure of 80 lbs., but, should more power be required, are good for 120 lbs. The steam is carried from the boilers to the engine, a distance of 200 feet, in covered pipes and without appreciable loss.

The dynamo is a large one (150 kilowatts), and was made and supplied by the Canadian General Electric Co., of Peterborough, Ontario, Canada. It is run from engine by an endless perforated belt 15 inches in width. The speed at which it is run is 640 revolutions, giving 340 amperes at a pressure of 250 volts. This low pressure, although tending to loss in the mains, gives entire immunity from danger, which is absolutely necessary in a mine where it is almost impossible to keep workmen from coming in contact with the wire. Spare armatures are always kept in reserve, so that there are never any delays for repairs.

The power house, containing engine and dynamo, is a large building 60 by 32 feet, and most complete in detail, having been specifically designed for the purpose. It has capacity enough to contain another plant the size of the present one, and in addition provides a store room and work room for winding armatures, etc., all of the work being done on the premises.

There are five locomotives, all of which were made in Canada, four by the Canadian General Electric Company, of Peterborough, and one by the Royal Electric Company, of Montreal. Four of the motors weigh 8 tons each, and are capable of hauling 40 tons of coal along a level track at the rate of 6 miles per hour. The other locomotive is a small one (4½ tons), and only draws 20 tons at a trip. The distance of road along which coal is hauled is two miles in one level, making four miles for the round trip, and in the other level where the other motor is worked the distance is one mile, or two miles for the complete run. In addition to the locomotives there is a 30 h. p. electric hoist, operating an endless rope on one of the slopes.

The line conveying the current from the surface to the shaft and down to the bottom, a distance of 1,000 feet, is a 0000 copper cable, well covered to protect it from water, and hung on strong insulators. From the bottom of the shaft and extending throughout the mine, the trolley wire is smaller—000 wire and suspended from the roof or timbers of the gallery by specially made insulated hangers, and held in position over the rail in

rounding curves by side wires or pull-offs, which are also insulated. A second or auxiliary wire (insulated) is carried in the levels as a feeder, to which the trolley wire is attached at stated distances.

The plant is fitted up with all the latest contrivances, switches, automatic cut-offs, safety fuses, etc., and in addition to the work mentioned, supplies light for the engine rooms, boilers, pit-head and other buildings on surface, and the whole of the pit-bottom and stables below ground, also all important sidings or partings. Each locomotive is fitted with head lights.

TWO SYSTEMS OF FIRING A WATER TUBE BOILER.

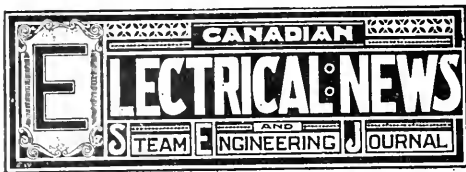
BELOW is given the results of two systems of firing a water tube boiler, conducted by Mr. George H. Barrus, at the Edison Electric Illuminating Company's power house, Boston. The first test consisted in the common method of spread firing, carrying a bed of coal 6 to 8 inches thick, and on the second trial a brick roof was inserted above the lower row of tubes, covering over half the length of the furnace, the flames passing to the rear end before the gases were discharged into the tube space. A second roof was placed above the upper row of tubes in front of the flame plate. The length of tubes was 8 feet, and the first roof extended backward 4 ft. 6 inches, leaving opening 3 ft. 6 inches. The upper roof extended forward 4 ft. 6 inches. The method of firing on the second trial consisted in the coking system, with 18-inch fire on forward part of grate, and a very thin fire at the extreme rear end. Green coal was fired only on forward part of grate.

The boiler was 325 h. p., constructed with two sets of headers connected by short pieces of pipe; the tubes, 168 in number, were of the ordinary 4-inch size, 18 ft. long, and arranged in two banks, 14 sections wide, with six in each section; two steam drums, 44 in. in diameter; area of heating surface of boiler, 3,737 sq. ft.; area of grate surface, 58.3 sq. ft.

Instead of the coking system showing a more perfect combustion of gases, as expected, the actual result was a loss, the difference being 5.3 per cent.

DATA AND RESULTS OF EVAPORATIVE TESTS ON 325 HORSE-POWER BABCOCK & WILCOX BOILER MADE WITH NEW RIVER SEMI-BITUMINOUS COAL.

System of firing	Ordinary	Coking, with brick roofs over furnace.
Percentage of moisture in coal,	2.4	2.5
Date of test,	April 14	April 21
TOTAL QUANTITIES.		
1. Duration,	8.	8.48
2. Weight of dry coal consumed including wood equivalent,	8,011.	10,738.
3. Weight of ashes and clinkers,	357.	514.
4. Percentage of ashes and clinkers,	4.4	4.9
5. Weight of water evaporated,	89.3.	92.4.
HEAT QUANTITIES.		
6. Coal consumed per hour,	1,002.5	1,279.2
7. Coal per hour per square foot of grate,	18.5	21.3
8. Water evaporated per hour,	10,413.6	10,779.
9. Equivalent evaporation per hour, feed 100 degrees, pressure 70 pounds,	9,932.	10,689.
10. Horse-power developed, A. S. M. E. basis of 33 pounds H. P.,	137.7	156.1
11. Equivalent evaporation per square foot of heating surface per hour,	2.7	2.9
AVERAGES OF OBSERVATIONS, ETC.		
12. Average boiler pressure,	157.2	155.1
13. Average temperature of feed water,	127.1	126.2
14. Average temperature of the gases,	476.	476.
15. Average draft suction, .....	.45	.54
16. Weather and outside temperature,	Cloudy, Moderate.	Cloudy, Moderate.
RESULTS.		
17. Water evaporated per pound of dry coal,	9.1	8.691
18. Equivalent evaporation per pound of coal from and at 212 degrees,	10.508	9.804
19. Equivalent evaporation per pound of combustible from and at 212 degrees,	11.051	10.404



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Influence of the
Telegraph.

"THANKS to the telegraph," said Lord Dufferin at the annual banquet of the British Chamber of Commerce of Paris, "the globe itself has become a mere bundle of nerves, and the slightest disturbance at any one point of the system sends a portentous tremor through its morbidly-sensitive surface."

International Elec-
trical Congress.

As we go to press, an International Electrical Congress is in progress at Geneva, under the auspices of the Swiss Society of Electrical Engineers. The prominent electrical societies of Europe and the American Institute of Electrical Engineers are giving their support to the undertaking. The following subjects are set for discussion: "Magnetic Units," "Photometric Units," "Transmission and Distribution of Power to Great Distances by Means of Direct and Alternating Currents," "Protection of High-pressure Overhead Electric Lines against Atmospheric Discharges," "Various Disturbances Caused by Electric Traction."

Prices of Incandescent
Lamps.

PROBABLY in no department of electrical supplies has competition and the cutting of prices been reduced to so fine a point as in that of incandescent lamps. Prices have eventually got down below the profit line, and as a result the American manufacturers recently held a conference in New York, at which an understanding is said to have been reached which is expected to put a stop to the disastrous under-cutting of the past. Each company is said to have deposited the sum of \$5,000 as a guarantee of its willingness to abide by the agreement, and a fine of 10 cents per lamp will, it is said, be imposed for selling below standard rates. Future prices will range from 22 cents for lamps of 8 to 25 c.p., to \$1.65 for

lamps of 150 c.p. in broken lots, and in standard packages from 20 cents to \$1.50. The management is said to have been vested in a committee. Some of the companies interested deny that such an organization has been effected.

The Duty on Steel Rails.

THE Privy Council has just handed down its judgment in the case of the appeal of the Toronto Railway Company for recovery of upwards of \$50,000 which the company were compelled by the Dominion Government to pay as customs duty on steel rails imported for use in the reconstruction of their system. The Exchequer and Supreme Courts of Canada upheld the interpretation put upon the tariff by the Minister of Customs, but the Privy Council has come to a contrary conclusion and has decided in favor of the plaintiffs' contention that steel rails for street railway purposes are entitled to free admission in the same manner as steel rails for use on steam railways. This is undoubtedly the common-sense view of the matter. The Toronto Railway Company deserve the thanks, if nothing more, of every electric railway company in the Dominion, for having fought the matter through and secured from the highest tribunal in the Empire this favorable decision which cannot be reversed.

The Kelvin Celebration.

SCIENTIFIC men from all parts of the world assembled in Glasgow the latter part of June to participate in the celebration of the 50th anniversary of Lord Kelvin's occupancy of the chair of Natural Philosophy in the University of Glasgow. During half a century Lord Kelvin has been an indefatigable investigator of the laws governing electricity and the methods of applying the same for the benefit of mankind. He is the author of many devices, notably measuring apparatus, which are the recognized standards in use throughout the world at the present time. He received the honor of knighthood for valuable services rendered in 1858 in overcoming difficulties incident to the successful operation of the first Atlantic cable, and was elected to the peerage in 1891. The celebration included a conversation by the University of Glasgow, at which were exhibited Lord Kelvin's inventions; addresses by home and foreign university bodies, learned societies and students of Glasgow and other universities, and a public banquet by the corporation of Glasgow.

Municipal Lighting

PUBLIC lighting in England is largely in the hands of the municipalities. The extent to which this is the case is indicated by the fact that a Municipal Electrical Association has been formed, which has just held its first convention. In Canada not more than half a dozen municipalities own and operate their own lighting plants. The citizens of the town of Goderich have lately voted in favor of the purchase of a municipal plant, and the town of Newmarket has the subject under consideration at the present time. It is difficult to determine from a few such isolated cases whether or not the municipal control idea is likely to grow to important dimensions, as it has done in England. Should it do so, the sales agents of the electrical manufacturing and supply companies will require to be trained in the ways of the politician, so as to be able to secure the votes of the councilmen or aldermen in favor of their particular apparatus. The man

who can "pull the wires" (no pun intended) most skillfully will probably secure the orders, regardless to a large extent of the superiority or inferiority of his goods. This method of selling goods promises to occupy a great deal more time and to cost more money than the selling to private individuals or companies, as at present.

Disturbance of Telegraph and Telephone Circuits

THE German Imperial post-office has compiled statistics which show a steady increase in the number of disturbances to telegraph and telephone circuits as the result of the multiplication of electric railways. In our last issue we published the decision of the courts in an action brought against the Montreal Street Railway Company by the Bell Telephone Co., for injury sustained as the result of disturbance of their circuits from the action of induction currents emanating from the street railway company's wires. The decision was adverse to the plaintiffs. Our readers will be interested in knowing the method employed by the German authorities to protect the telegraph instruments from high pressure currents. For this purpose fuses are put into the circuits. These fuses consist of a wire 0.07 mm. in diameter, and made of a non-oxidisable alloy. They are enclosed in glass tubes 5cm. to 6cm. long, sealed at both ends, and fitted with metal contact pieces. In this way the formation of an arc at 500 volts pressure is avoided. The fusing current of the wire is 0.8 amperes. The whole fuse is kept in position between contact springs, and is easily interchangeable. Another type of fuse used by the Imperial post-office consists of a porcelain block about 5cm. high, the fuse wire running through a hole across the block. Both types have given satisfaction.

Acetylene Gas.

THE possibility of acetylene gas becoming a competitor of electricity as an illuminant, has greatly disturbed the minds of a considerable portion of the electric lighting fraternity. There is no room for doubting that the illuminating power of the gas is very greatly superior to that of ordinary gas; and that if it were merely a question of light it might perhaps become a very formidable rival to electricity. But the question of cost comes very prominently into consideration and here it is that we meet the strongest argument against it. It is not merely the cost of the carbide itself that must be taken into account, but that of all the accessory devices, the secondary receiver, the pipes, fixtures, etc. As to the cost of manufacture of the carbide, there are so many conflicting estimates, statements, and claims, that we consider ourselves amply justified in taking up a very conservative position, and saying that there will have to be a very considerable degree of higher mutual corroboration and unanimity among writers on the subject before the public can be expected even to form an opinion on the subject, much less to make any investments. One writer of undoubted scientific qualifications says, "Present average cost of illuminating gas in the holders of the large gas companies approximates 30 cents per M, while the cost of acetylene gas in the holder, with calcium carbide at \$37.60 per ton, would be equivalent light for light, to illuminating gas at 37 7/10 cents per M, making the cost of pure acetylene per candle power approximately 20 per cent. higher than that of ordinary illuminating gas." If acetylene were mixed with air, no doubt the cost would be lower, but the advisability of distributing the mixture through

a city would be very questionable, owing to the risk of the mixing being improperly done, and the quantity of acetylene falling to such a percentage as to form an explosive combination. Any person using the gas in their houses would require a duplicate holder, so that one might be charging while the second was running. As the gas in holders would be at a pressure of over 600 lbs. to the square inch, a valve would be required to reduce it down to that required at the burners. No doubt such a valve is obtainable but would require attention which the average householder would not or could not give. A failure of the valve would entail the escape of the gas. It would appear that considerations of cost and convenience go to show that, at the present at least, the incandescent lamp has nothing to fear from acetylene gas, which may find its way into the residence of an occasional wealthy householder, but not into general use.

Antiquated vs.
Modern Apparatus.

WE would bespeak a most careful study of the very valuable paper presented by Mr. Gossler before the last meeting of the Canadian Electrical Association. A very large number of our readers are personally and financially interested in electric lighting stations; and as a great proportion of these stations date from the time when electrical machinery had not received the careful study that is now devoted to it, it is only reasonable to suppose that the apparatus used is of the very inefficient types that characterized the early days of electric lighting. Transformers have only of very late years received much consideration, but the study of the conditions under which they operate, and the principles involved, has led to very great and beneficial changes being made in their construction. The saving effected by the changes indicated by Mr. Gossler, resulted from the substitution of modern high-class transformers for the old type ones previously in use; and nothing can more vividly illustrate the difference in value between old type cheap goods and new type expensive ones than the fact, as stated by him, that the annual savings effected by the new transformers will pay for their cost in about 2½ years. In smaller electric lighting plants nothing is more usual than to make selection of machinery and apparatus on the basis of cost solely, i. e., they choose that one that costs the least money. This is really the most expensive policy to adopt, and as the knowledge of electrical investors extends, with respect to the machinery they operate, and what goes on while current is flowing, it will become more and more evident to them that to buy modern, superior, and therefore high-priced machinery, gives a far better investment than cheap stuff. One frequently meets men whose knowledge of electricity is so comprehensive that they know it all. These persons will of course never learn anything, but the earnest electrical student every day becomes more convinced of the fact that the more he studies, the less he finds he knows. The influence that transformers can exert on the profits of an electric plant is so appreciable that we recommend all owners to very carefully examine into the efficiency of that part of their installations.

A writer in Electricity of London, with fluent inaccuracy, says the Western Electrician, notes that the new president of the "National Electrical Association" is "Mr. Frederick, who is an Englishman." Doubtless the intention was to convey the idea that Frederic Nicholls, lately elected to the presidency of the National Electric Light Association, was born in England.

NOTES FOR ENGINEERS.

To pack piston pumps for kerosene, cup leather, such as is used in packing hydraulic pumps will be necessary.

Have a regular system for doing your work in the engine and boiler rooms and have a time and place for everything.

Long grate bars make hard work for the fireman, and he cannot always keep the back grate of the furnace in good order. A short wide furnace is the best.

When using the ordinary brass check valves, it is a good idea to use one size larger than the pipe calls for, as the water will then flow through them with less friction.

After taking a ground joint apart clean it well, and before putting it together again, oil it thoroughly and if it is to be exposed to heat use cylinder oil for this purpose.

When piping up a plant, use angle valves wherever convenient, as you will then have less joints to make up, and angle valves offer less obstruction to the passage of steam than globe valves.

For removing scale from boilers, or rust from any metal, use kerosene oil. To loosen a nut which is rusted to a bolt, saturate with kerosene. It is simple, but by all odds the most effective rust or scale solvent.

There are two methods of obtaining the heat value of coal; one by burning a representative sample in some kind of oxygen calorimeter, and the other is to analyse the coal and equate the elements with their heat values. The oxygen calorimeter is generally preferred, but some engineers prefer the analysis.

One pound of good coal is equal to about four-tenths of a pound of wood without regard to the quality of the latter. Some woods contain more water and sap than others, some are dense while others are porous, but considering the pure wood fibre, all woods are practically the same so far as their value for fuel is concerned.

If you are using a power pump for feeding your boiler and there is no way to regulate the amount of water delivered, connect a ½ inch pipe into the discharge pipe and also into the suction pipe, with a valve to regulate the circulating water. By opening this valve the amount of water delivered to the boiler may be diminished, and so a uniform water level maintained.

If the safety valve leaks and grinding it in affords only temporary relief it may be caused by impurities in the water causing a thin scale to form on the valve and seat, and after the valve has been opened once it leaks until ground in again. I have known soda ash, used as a boiler cleanser, to do this, but when its use was discontinued and oil used instead, the trouble disappeared.

On taking charge of a steam plant the engineer should at once acquaint himself with the peculiarities of the engine, and next should acquaint himself with the peculiarities of the proprietor or superintendent. One is just as essential as the other, for each will need an equal amount of "managing" if the engineer is to make an unqualified success of running the plant. Some good engineers make a mistake here and fail accordingly.

If your injector has been in use for several years and is not as reliable now as it was when new, do not throw it away, calling it worn out, until you have carefully cleaned it with a solution of muriatic acid and water. Disconnect the injector, put corks in the outlets, and fill it up with the solution, letting it stand over night. Wash out in the morning with water under pressure, and see if it is not as good as new. The solution should not be stronger than about two parts of water to one of the acid.

In case of accident in your boiler room, where prompt reduction of the temperature under the boiler is necessary, too great care cannot be exercised by your fireman. As a rule he will proceed at once to "draw the fire," but if the boiler is in a critical state, such an act is certainly not wise. When a fire is disturbed, the heat which it gives out is materially increased for several minutes, and unless the entire body of the fire can be removed at one stroke, the safest plan is to smother with damp ashes or fresh coal.

Many a leaky piston or valve rod which is chronically so, could be cured by turning the piston so that the worn place at the bottom would come at the top, or by putting a liner at the bottom to carry the piston at a higher level. Sometimes the bottom part of a piston has been drilled, and the holes filled with hard Babbitt to raise the piston up into line. Sprung rings of cast iron or brass cannot be depended on to centre a piston or keep it in line, because of the wear. Babbitt plugs will serve such a purpose, and they can be renewed when occasion requires. This is an easier and cheaper way than having a new piston made

ASBESTOS.

THERE is probably no production of inorganic nature about which there is so much popular mystery and misconception as asbestos. It is vaguely understood that the principal claim of this remarkable product to attention is that it cannot be consumed by fire, and not infrequently the effect of the mention of asbestos is to carry the hearer back to the days when the people of the Pharaohs wrapped their dead in cere-cloths, woven from fibre, in order to preserve them, the body having been first embalmed. Romantic stories have also come down to us of ancient demonstrations of magic in which asbestos has played the leading part, but the real interest in asbestos centres in the present. It is of more importance to the human race to-day than it has been in the whole range of history. Asbestos twenty-five years ago was practically not known in the laboratory of the chemist or mineralogist. It now finds its way in one form or another into every workshop where steam is employed.

To the question, "What is asbestos?" it is not altogether easy to find an answer. Geologists classify it among the hornblends. In itself, asbestos is a physical paradox, a mineralogical vegetable, both fibrous and crystalline, elastic yet brittle, a floating stone, but as capable of being carded, spun and woven as flax, cotton or silk. It is apparently a connecting link between the vegetable and the mineral kingdom, possessing some of the characteristics of both. In appearance it is light, buoyant and feathery as thistledown; yet, in its crude state, it is dense and heavy as the solid rock in which it is found. Apparently as perishable as grass, it is yet older than any order of animal or vegetable life on earth. The dissolving influences of time seem to have no effect upon it. The action of unnumbered centuries, by which the hardest rocks known to geologists are worn away, has left no perceptible imprint on the asbestos found embedded in them. While much of its bulk is of the roughest and most gritty materials known, it is really as smooth to the touch as soap or oil. Seemingly as combustible as tow, the fiercest heat cannot consume it, and no known combination of acids will destructively affect the appearance and strength of its fibre, even after days of its action. It is, in fact, practically indestructible. Its incombustible nature renders it a complete protection from flames, but beyond this most valuable quality, its industrial value is greatly augmented by its non-conduction of heat and electricity, as well as by its important propriety of practical insolubility in acids.

Asbestos has been found in all quarters of the globe. It comes from Italy, China, Japan, Australia, Spain, Portugal, Hungary, Germany, Russia, The Cape, Central Africa, Canada (Fig. 1), Newfoundland, this country, and from Southern and Central America.

Notwithstanding this wide distribution of asbestos, the only varieties which at present appear to demand serious consideration, from a commercial point of view, are the Russian, the South African, the Italian and the Canadian.

Before the development of the Canadian fields, the Italian

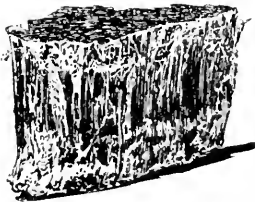


FIG. 1.—CANADIAN ASBESTOS.

asbestos was supreme in the market. For nearly twenty years Italy has been looked for the best grades of the fibre. From a point on the northern mountain slope of the Susa valley is taken the floss asbestos fibre, the appearance of which in gas stoves is so familiar. In the same locality is found a fine white powder of asbestos, which serves for paint and other purposes. The mining is carried on at a height of from 6,000 to 10,000 feet above sea level.

But the Italian asbestos industry, once so important, is already on the down grade. The difficulties of mining are very great, and unduly increase the cost of production. The asbestos itself, judged by the latest standards, is of inferior quality; it is not easy to spin, and it does not pulp well in the making of paper. The best grade is extremely rare, and its cost of mining and transportation is prohibitive. The supply from the Italian mines

is rapidly falling off. As a matter of fact, Canada contains the great asbestos region of the world, in the sense that while its mines are practically unlimited in productive capacity, the product is of a quality which fully meets the requirements of the newest and most exacting of the innumerable uses that are daily being found for it.

The process of manufacture is intensely interesting, more especially from the fact that as the industry is constantly entering upon novel phases, new methods of treatment and special machinery have to be devised. One of its special uses is for wall paper.

One of the largest branches of asbestos manufacture is that of sectional cylinders for pipe coverings, for retaining the heat of steam and other pipes, felt protective coverings for boilers, frost-



FIG. 2.—ASBESTOS MINING.

proof protections for gas or water pipes, and cement filling, which can be laid on with a trowel, for the covering of steam pipes, boilers or sills. In some of these cases, where it is only necessary to retain the heat, the asbestos is mixed with other substances; but where the protection must be fireproof as well, only asbestos is used. The utility of such covering is well illustrated in the heating system of railway cars. The main pipe from which the individual cars draw their respective heat supplies by side mains, if not covered with asbestos, would lose a large proportion of its caloric from the rapid motion of the car through the air. An interesting innovation in this class of manufacture is asbestos sponge. It is not generally known that sponge has great powers of fire resistance. The discovery was made accidentally not long ago, and the result was that a consignment of scraps of sponge picked up on the Southern coasts was ordered for experimental purposes. The sponge was finely comminuted and mixed intimately with asbestos fibre. The combination was found so successful for any covering which had to be fireproof as well as heat-proof that the material has become standard. Being full of air cells, it necessarily makes an excellent non-conductor. Another very extensive department in asbestos manufacture is that of packings. Of these there are an infinite number of forms. In these days of high pressures and ocean records, it is of supreme importance to marine engineers that they should have jointing and packing materials on which absolute reliance can be placed. In order to meet modern exigencies every possible form of packing has been constructed, particularly with asbestos and metallic wire, and with asbestos and rubber cores for gland packing. The making of asbestos paper varies from the building up of the thickest millboard to the production of a writing paper which, from its indestructibility, is valuable in case of fire for preserving charters, policies, agreements and other important documents.

To the electrical engineer asbestos is absolutely indispensable. Many parts of electrical devices and machinery and wires through which the electrical current passes become heated, and were it not for the electrical insulation and heat-resisting qualities which asbestos possesses, the apparatus would be completely destroyed, particularly in the case known to electricians as "short circuiting." For such purpose it has been found advisable to combine asbestos with rubber and other gums, and this combination is now

used universally for not only electrical, but also steam and mechanical purposes.

The newest departure in the asbestos field is the construction of electrothermic apparatus. The heating effect of the electric current is utilized by embedding the wire in an asbestos sheet or pad. The pad is used by physicians and nurses for maintaining artificial heat in local applications, and is said to be already largely used in hospitals. Another application of the same principle is to car heaters. A sheet of asbestos, with the embedded wires, is clamped between two thin steel plates, and the portable heater thus provided, or a series if need be, is connected to the car circuit quickly and easily. It gives an even and healthy heat, and can be so regulated as not to overheat the car.—George Heli Guy, in New York Evening Post.

THE TELEPHONE IN RAILROAD PRACTICE.

THE growing use of the telephone in railroad work and its present advantages and future possibilities is a subject well worthy of consideration and study.

The telephone equipment at local points best adapted to the transmission of the internal business of a railroad, depends upon the location and the degree of concentration of the offices at each point. The value of a private telephone line connecting intermediate points and the division headquarters along the line of the road is dependant to a large extent upon the number of instruments that are enabled to secure intercommunication thereby.

In connection with the speaking tube or internal telephone system, special efforts are being made by the local telephone companies to offer the railroad companies instruments and apparatus that vary with the character of the service desired. For instance:

System A—A central switch with lines radiating from it, each line having one or more stations connected with it, the whole being arranged for intercommunication.

This system is operated in much the same manner as an ordinary telephone exchange, a switch being located at some central point, provided with a means for calling and receiving calls from each station, and for connecting the several stations with each other. The switch may be located where it can be operated by some person in connection with other work, or if the system is large, the services of a regular operator may be required.

This system (if but one station is connected on each radiating line) secures secrecy between any two stations and provides for independent communication between a number of stations at the same time.

System B—A switch at a particular office with lines radiating from it, each line having one or more stations connected with it, the whole being arranged for communication to and from this particular office, but not for communication between stations on different lines.

This system is used for transacting business between a particular office and several stations in cases where it is not required that the stations communicate with each other. A switch is provided at the main office only.

This system (if but one station is connected on each radiating line) secures secrecy between the main office and any one of the stations.

System C—A switch at each station, with means for connecting the instrument at such station with lines extending to each of the other stations.

This system is so arranged that a person at any station can call any other station over a special line and establish the desired connection without the aid of an operator. It does not secure secrecy to such a degree as systems "A" or "B." A switch being located at each station, access may be had to all circuits whether in use or not, but as the bell at the desired station is the only one operated when a call is made, secrecy is fairly assured, and interruptions are not likely to occur unless the use of the same circuit should be desired by a second party and his instrument be connected for the purpose of making a call. It is possible for parties at several stations to converse independently with each other at the same time.

System D—A single circuit connecting two or more stations.

All instruments being connected upon one circuit, no switching apparatus is required. Only two stations can use the line at one time and there can be no secrecy, as a call made from any station will ring all bells simultaneously.

Systems "A" and "B" are especially adopted and serviceable for freight offices and yards, round houses, switching towers, etc.

System "C" is perhaps the most convenient and satisfactory when the stations to be connected are not numerous.

System "D" is the most simple and inexpensive.

An outgrowth from system "A" is the present private branch telephone exchange. The benefits derived from the establishment and operation of private branch exchanges seem comparatively unknown, and especially so to those who have not been closely in touch with the growth of this particular line of the business, and it is with a view of arousing interest in this direction, as well as securing additional information through the discussion which I trust will follow this paper, that I have endeavored to collect as much reliable information as possible bearing upon the subject. This very lack of familiarity with the branch exchange frequently results in a much less efficient service from a given number of telephone lines than would be secured were they merged into the so-called exchange.

"In the march of civilization the improvements of yesterday are discarded for those of to-day. The tin speaking tube once used for interior communication gives way to the telephone. In this age when only time saving is considered more important than labor saving, and the combination of both is the prime object with all active minds, the importance of rapid and reliable communication can not be over-estimated. Especially true is this of the business conducted in a large building where the labor and delay incidental to employing messengers or office boys, make an important item of expense. In the general offices of a large railroad company, where every office can be connected one with another, and the various working departments be brought into talking relations with one another, this telephone service is a time, money and labor saver; and where the heads of departments are separated from each other by doors, stairs and passages it is invaluable."

Every railroad man is familiar with the general scheme of railroad organization, and the relationship between the various departments, their chiefs, etc. The lines of authority are closely drawn, and the flow of communication naturally follows these divisional lines.

As the division of responsibility among the several officials and employees who carry on the operation of the railroad company is plainly defined, so the use of the telephone tends to parallel those divisions of responsibility and to follow the lines which separate the duties which are to be performed.

In the application of the telephone to the transaction of internal business at local points and within a certain radius of the office building or about the yards and switching centers, the numerous communications necessary are passed to and fro easily and without loss of time.

The tendency is towards the constant growth of private branch exchanges, as they give more perfect interchange of communication for every class of business, concentrate the service within certain limits and enable the business to be transmitted direct without going through the medium of the local telephone operator, and vary the class and extent of the service desired according to the price paid.

The benefits to be derived from the operation of the private branch exchange have been recognized to a greater extent in the city of Chicago than elsewhere in the country. As a matter of fact there are at present in that city over 130 private branch exchanges, operating an aggregate of over 1,200 telephone instruments. These exchanges are operated by railroad and express companies, large wholesale and retail establishments, manufacturers, etc., and range in extent from four to 100 instruments. They are connected by means of trunk lines with the local telephone company's exchange, so that connection may be had with the public.

In a great many cases a particular telephone, while greatly needed for the handling of railroad business, has no occasion for public connection. If arranged so that they can secure such connection, the result is that the telephone will be used more or less for private ends; consequently, when the public trunk lines are required for legitimate railroad business, they will be reported "busy," while as a matter of fact, they are being used for private business.

To obviate this evil and to furnish as nearly as possible what is absolutely required, the local telephone company has recently adopted a scheme whereby it is made impossible to give certain offices public connection, although they are able to secure unrestricted intercommunication with every line radiating from

* Paper read before the Association of Railway Telegraph Superintendents, Fort Monroe, Va., June 17, by W. W. Ryder, Chicago.

the branch exchange. In giving this limited service, the telephone company charges considerably lessened rental, although securing for the subscriber a more efficient service by not allowing the unnecessary blocking of his down-town trunk wires. This difference in expense together with the difference in price between public and branch exchange lines is almost, if not quite, sufficient to pay the salary of the telephone operator even though you have only a small number of lines, and this naturally increases with the greater extent of the system.

The success of the system can best be indicated by the statement that of all the branch exchanges put in operation in the city of Chicago, only one has ever been taken out through dissatisfaction with the system, and in this case it was only a short time before the telephone company was requested to immediately replace, the firm finding that the inconvenience and loss of time were greatly increased when the exchange was closed.

The growth of the private branch exchange system must soon extend along the lines of the individual roads; in fact, at present the Pennsylvania Railroad Company has in operation a very complete system which gives them direct connection over wires entirely controlled by them between all division headquarters on their road east of Pittsburgh. Through the courtesy of that company I am permitted to exhibit a diagram of this system. They have branch exchanges at all division headquarters and have leased from the Long Distance company necessary wires to complete connections with these points. Other large eastern lines, I understand, are now contemplating the adoption of this same scheme.

With the growth of the private exchange idea, these exchanges will rapidly multiply in large cities and the necessity for means of intercommunication between them without going through the public exchange will become imperative; in fact, in the city of Chicago, at present, where branch exchanges are being operated by the Chicago & Northern Pacific, Chicago, Rock Island & Pacific, Chicago, Milwaukee & St. Paul, Chicago & Eastern Illinois, Illinois Central, Chicago & Northwestern and Chicago, Burlington & Quincy Railroad companies this necessity is very noticeable, and the local telephone company is considering the question of trunking the different exchanges together. With this accomplished, it is but a step to the connection of the branch exchanges in one city with those in another over wires controlled by the railroad companies. How this can best be done can only be decided by trial, and I believe we will have to meet this particular issue at a very early date.

When we consider the rapid growth of the telephone system, it seems a question of only a short time before the telegraph will be largely superseded by the telephone. It has been shown in actual practice in commercial service that messages of 30 words can be read and intelligently transmitted in a quarter of a minute, or 120 words per minute, which is about 3,000 better per hour than the average by Morse, using the Phillips code and the typewriter. The above record is taken from a guaranteed service where the toll service is daily performed on this basis.

The question of the telephone not being able to compete with the telegraph on account of the lack of records was happily answered, you will recollect, by Superintendent Selden in a paper read before this association at the 1894 meeting, and this feeling, I believe, is rapidly passing away.

The despatching of trains by telephone has been tried with perfect success in several instances in this country. This is the most exacting of service, and the fact that it is a success speaks volumes for its efficiency.

It is a well known fact that large corporations are slow in adopting radical changes, but the improvements in telephone apparatus are so marked and the benefits derived from its use so evident, that they are being forced to recognize its merit and consequently are rapidly advancing the movement.

One-half a square inch of piston area per horse power is a common rating for steam engines.

If the girth seams of a tubular boiler leak and chipping and caulking do not stop it, be sure there are no cracks in the plate, or that defective rivets are not the cause of it. If the boiler is sound, the trouble may be caused by unequal contraction of the plates due to the introduction of comparatively cool feed water into the bottom of the boiler. If the location of the feed pipe is changed the leakage may cease without further attention. The water should be discharged into the body of the water already in the boiler, and not on the bottom sheets.

ELECTRIC LIGHT INSPECTION.

THE divisional inspector of electric light, Mr. Wm. Johnson, of Belleville, was here several days last week, during which time he has inspected all the electric light meters and also has been looking into the voltage or pressure carried by the company. It will be remembered that the Government fitted up apparatus in the post office building, but to suit the convenience of the Light, Heat and Power Co., the inspection is now done at the premises on William street. Mr. Johnson was not stinted in his praise of the test board and other appliances supplied by the ingenuity of Mr. H. E. Reesor, who, Mr. Johnson says, in the fitting up of these, has shown his ability as an electrical engineer. It has proved fortunate for the users of electric light meters that they have been brought under Government inspection, if they are everywhere as they are here. It must be understood that the company here accepted the meters from the manufacturers as correct and had their guarantee that they were; but, when tested by the Government standards, the majority of them have been found to be too fast, or, in other words, against the consumers. One meter only was found too slow and it was sixteen per cent. that way, while many of them were from seven to nineteen per cent. fast. All the meters in town have now been adjusted or regulated in the inspector's presence and have been sealed by him. The inspector explained to us that the Electric Light Inspection Act requires each company to state to all its customers the rate of voltage at which it will supply the electricity; the company here proposes to do this at a voltage of 104, but the inspector found that the company was furnishing it at from 100 to 112 volts and informed the company that it was liable to a penalty for increasing or diminishing the voltage beyond or under three per cent. of 104 volts. The reason for this provision of the law is that if the voltage is greater than the amount specified it destroys the lamps, or if less than it should be the light is diminished. A number of our citizens visited the Light, Heat and Power Company's office while the inspector was here, and had explained to them the interior of that mystical looking object an electric light meter, also how the meters were tested, and the meaning of some of the technical terms used by the electric light fraternity.—Canadian Post, Lindsay, Ont.

The inspection by the Government of all the electric light meters in town was concluded this morning, nearly one hundred and fifty having had the red seal attached to them. The Government regulations give the electric light companies until the first of next June to have all their meters tested, after which it will be unlawful for them to use any other. A penalty of \$25 is to be inflicted after that date on any company or person who uses a meter which has not been inspected and stamped.

The Peterborough Light and Power Co. has done a popular thing in having its meters tested at once, and in this way again has given evidence of how well it keeps its finger on the public pulse, and have met the universal clamor for inspected meters.

The inspector, Mr. Wm. Johnston, informs the REVIEW that of the hundred and fifty meters tested, about a dozen were incorrect, six were 5 p. e., a couple 8 p. e., and two 12 p. e. too fast, or in favor of the company, while one, where the customer uses ten lights, had not registered but a small percentage of the energy, owing to part of the gearing having got wrong, the customer's bill for last quarter having been only \$1.80. These cases, however, prove the value of the inspection. By a strange "irony of fate" the two meters that were twelve per cent. too quick were in the residences of two of the officers of the company.

Mr. Johnston also says that the work of inspection, which it was first intended should be done at the gas inspector's office in the Custom House, was accomplished much more quickly at the offices of the Light and Power Company where through the ingenuity of Mr. Fisk, the company's clever electrician, facilities were provided.—The Daily Review, Peterborough, Ont.

If the guides on an engine are made separate from the frame, they may be taken off and planed when they need it, but if they are cast with the frame this cannot be done.

For lubricating pump rods, a very good mixture is made from tallow, cylinder oil and plumbago; and if the water is warm, it is better to add a little beeswax. This, mixed with the fibers of the rod packing, will greatly improve the ease of running and will keep the rod in good condition; and, in fact, this good waste may be used to replace expensive packing if the waste is properly laid up.

WIRE INSULATION.

By H. W. NELSON.

THE insulation of wire for electrical purposes has grown into a large and important industry in this country during the past ten years. For the lack of the right kind of commercial and scientific attention it has grown up very badly in certain lines, viz., those relative to lighting and transmission of power, which are the lines covering by far the larger part of the business.

On the other hand, the manufacture of telegraph and telephone wires, notably the telegraph, has been brought up to a splendid state of efficiency, both commercially and scientifically. The reason is not far to seek, when we consider that such men as Lord Kelvin, Edison, etc., have not thought the minutiae of this branch too small to engross their colossal minds, and that the manufacturers have co-operated with them to turn out a good commercial article. In lighting and power transmission work, attention to the fine details of wire insulating has been positively shirked by the technical men, they having left their part to crude, untrained minds. A glance at the patents list, with its hundreds of ridiculous, foolish specifications for insulating wire, presents evidence of uneducated dabbling.

In conjunction with this neglect of the engineer there has been an almost entire absence of co-operation of the business man with the technical.

As a consequence of the striving of the one for cheap wire and the other for high quality, and no attention to the intervening details, the market has run into two channels: On the one hand a cheap and very poor insulation, and on the other, a high quality and very high price. There are a few grades between, of insignificant amounts, which do not affect the argument.

A friendly association on the part of these men, with a little more regard to the importance of the details involved, would in all probability have made a market for a fair-priced medium wire. For an instance, a wire is needed for interior and hidden work, to go on a 52-volt circuit alternating current from a 1,000-volt main line, or on a 125-volt circuit direct, constant current. For this a wire is demanded having an insulation resistance of from 800 to 1200 megohms per mile, and unless the engineer and underwriters are hoodwinked, a high-priced rubber-covered wire is put in which is capable of withstanding without rupture the shock of from 5,000 to 10,000 volts alternating. This appears an excessively large factor for safety, but with their present knowledge those on whom the responsibility lies cannot accept anything less costly, and take the risk of perhaps an early breakdown of their insulation. They have a general knowledge that an insulation compound made up with a large percentage of pure rubber will resist water and not be short-lived, and that a more attenuated compound, or another compound, may be good or rubbish. They cannot tell without the test of time, and not being familiar with its manufacture, they will not accept risks on another's ipse dixit. They therefore must stick to an extra superfine where an ordinary wire would do.

This ordinary wire, by which is meant a fair insulation resistance sufficiently long-lived, at a medium price, would undoubtedly be forthcoming if the market demanded it. In this regard, however, when the engineer does not demand anything more than an insulated wire, the purchasing agent has an opportunity to get something cheap, and the lowest tender gets the contract. This is the place where very poor stuff masquerades as

electrically-insulated wire. One very prominent kind, which is literally a whited sepulchre, is a wire covered with a braid or wrap of cotton, or other fibrous material, very hygroscopic, which is saturated with pitch, or some much vaunted insulating paint, to render it non-hygroscopic, which it does not; the whole then receives a plaster of whitening and fish-glue, or similar compound, to render it fire-proof, which it does not.

Then again, where the high cost wire is put in, the ends on the cut-outs, rosettes, etc., are often left bare or worse by being insulated with sticking tape, made of cotton (hygroscopic) and poor rubber compound which quickly oxidises, and against such weak spots a wire having an insulating resistance of 200 megohms per mile should be more than ample. In addition to this the flexible drop cords to the lamps have simply been called for in specifications as rubber-covered lamp cord, and the purchasing agent buys the cheapest article which can legally be labelled "rubber-covered." If a drop of salt water be dropped on this cord when the circuit is closed its quality will probably show up in a very bright way.

The insulation called "weatherproof," which is not weatherproof, however, serves the purpose for which it is generally used very well. It is generally used as a line wire on currents at a low voltage, and providing that the pole insulators are good, it simply serves as a separator, preventing a dead short circuit if stray wires of low voltage touch it. In choosing this wire, if the choice were made more with regard to its usefulness and life, and not so much to the highly polished surface, a saving in renewals might be effected without an extra first outlay, in that the money saved by foregoing the extra work in fancy finishing could be put into the material, by having a heavier, stronger covering.

It must be remembered that this covering only acts as a separator, that it soaks up water almost as a sponge, and that the end to be gained is that the covering required be strong enough to resist the rough usage it gets from the kerb-stones, posts, trees, road-gravel, etc., when the linemen are stringing it, and from the sun and rain afterwards. To this end it is necessary to put on two or more strong jute or cotton braids, and to saturate them with a compound which will stick the braids to the wire and preserve them from rotting. There can be very little of the polish left when the wire is stretched on the poles after this handling.

The above somewhat short and imperfect remarks, if they succeed in calling attention to a very backward branch of electrical work, may suggest many ideas for improvement.

(1). It may be suggested that some of our prominent consulting engineers (men above financial interest in any particular manufacture) make a special study of this subject, in order to have more than a mere general knowledge of it.

(2). That the leading fire insurance companies together engage a man thoroughly experienced in wire insulating as a permanent inspector of insulations. (N.B. They already do something abortive in this direction.) That they fit him up with a laboratory, and have a sample of all wires tested and put on record before they are allowed to be strung, or

(3). That the government appoint this official and

(4). That a law be passed making it a misdemeanor for anyone to string wires a sample of which has not been officially accepted by the inspector.

(5) That our colleges give some open lectures on the chemistry, etc., of caoutchouc, resins, cotton, silk, waxes, and so forth, which are or may be useful as dielectrics or protectors to dielectrics.

A course on such lines as this would spread the gospel of insulation, and would make for progress, in spite of the stumbling blocks our rule of thumb men prove themselves to be, with their shellac and resin or such like compounds, of which they make such a "dark and bloody mystery."

THE UTILITY OF ELECTRIC CLUBS.

ELECTRICITY is now recognized as one of the greatest factors in the commercial world, and the number of new enterprises coming into existence, and for which the services of competent electricians, engineers, etc., are required, emphasizes the necessity of intending applicants such positions thoroughly fitting themselves for the same.

The formation of Electric Clubs in the different cities is probably one of the best means of education and improvement. The opportunity is thus afforded for the interchange of ideas and the presentation of papers on practical subjects of interest. The Montreal Electric Club enjoyed a period of usefulness during its existence, but owing to the removal from Montreal of some of its members, and the fact that the work was left largely to a few it has ceased to exist. We are pleased to learn, however, that an effort will be made this fall to revive the Club. It is a significant fact that many of the prominent members of this Club, which was composed largely of the younger electricians, have secured responsible and lucrative positions.

In the city of Toronto there is also a good field for the organization of a similar club. The number of electricians, engineers, students, etc., in Toronto, should be sufficient to ensure a fair membership. During the winter months meetings could be held, say twice a month, at which papers should be presented and discussions held upon subjects relating to the various departments of electrical work. It is hoped that steps in this direction may be taken before the season is too far advanced.

MODERN PRACTICE IN INTERIOR WIRING.

In the course of his paper on the "Evolution of Interior Conduits from the Electrical Standpoint," before the National Electric Light Association at New York, Luther Stieringer made the following statement:

The best experience in the past fifteen years in interior wiring has demonstrated the following facts:

First—Indiscriminate wiring with staples is universally condemned.

Second—Cleat wiring is admissible in exposed work where the circumstances admit, but not in concealed work.

Third—Wires imbedded in plaster, depending on the insulation only for protection, are condemned.

Fourth—Lead-covered wires are also condemned, except where protected in a conduit.

Fifth—Wires in mouldings do not afford mechanical or chemical protection, and are only admissible in surface work.

Sixth—Wires carried in plaster, and covered with split or zinc tubes to prevent injury by trowels, are condemned.

Seventh—Glass or porcelain insulators can only be utilized in special cases of exposed work.

Eighth—Paper tubes do not afford absolute mechanical and chemical protection.

Ninth—Insulated tubes covered with a thin coating of brass or other metals do not afford absolute mechanical and chemical protection, but in exposed work they are to a certain extent admissible.

Tenth—Woven fabric conduit does not afford absolute chemical protection.

Eleventh—Heavy insulating covering, integral with the insulation offers no absolute protection against mechanical and chemical injury, and is analogous to rubber tubing for gas distribution installed throughout a building.

Twelfth—Concentric wiring is practiced in England with satisfactory results, but it is not in use in the United States. It offers many possibilities in the direction of a solid and fixed system.

Thirteenth—Paper-lined iron or steel pipes, known as "iron-armored conduit," "builders' tube," "armorite," "Clifton," and plain iron or steel pipe, are the only conduits that can afford absolute security against mechanical and chemical injury and assure permanence.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO, NO. 1.

The regular meeting of Toronto No. 1 was held on the 15th of July. A pleasing feature of the meeting was the presentation of a family rocking chair each to Bro. T. Eversfield, engineer at Toronto University, and Bro. Wm. Butler, engineer at Nordheimer's piano factory. The presentation was made by the President, Bro. J. Fox, on behalf of the Association.

HAMILTON NO. 2.

At the regular meeting on the 3rd of July, the newly-elected officers were installed by Bro. A. E. Edkins, after which he gave a brief address in connection with the approaching annual convention. Bro. Pettigrew also spoke along the same line.

BRANTFORD NO. 4.

The following is a list of officers of the above association for the term ending June 30th, 1897: President, J. B. Forsyth; Vice-President, Jos. Ogle; Secretary, Thos. Pilgrim, Continental Cordage Co.; Treasurer, L. Fordham; Conductor, F. Temperance; Door-Keeper, A. McKinnon.

PETERBORO NO. 14.

At the regular meeting of Peterboro Branch No. 14, held in Engineer's Hall, the following officers were elected: President, W. L. Outhwaite; Vice-President, W. Forster; Secretary, A. E. McCallum; Treasurer, W. Taylor; Conductor, G. Pogue; Door-Keeper, P. Milloy. Mr. Outhwaite was appointed as the representative to the annual convention in Kingston.

BROCKVILLE NO. 15.

James Aikens, Recording Secretary of the above branch, writes: On the sixth of July we met in our rooms for the purpose of electing officers for the ensuing year. The following was the result: President, Archibald Franklin; Vice-President, John Grundy; Recording Secretary, James Aikens; Treasurer, John McCaw; Financial Secretary, Wm. Robinson; Conductor, Fred.

Andrews; Door-Keeper, John Boyd; Trustees, Ernest Carr, Edward Devine, James McRitchie.

Immediately after the election, the Past President, Bro. W. F. Chapman, proceeded to instruct the new officers in the discharge of their duties, his remarks being well received. The next part of the programme was a speech by Bro. Albert E. Henry, on the benefits which he received in the way of technical knowledge by joining the C. A. S. E. We all hope to see No. 15 prosper in the future as it has done in the past two years, when Bro. Chapman was leader, and no doubt the President's chair will be ably filled by Bro. Franklin, the veteran, and chief engineer of the water works in this town.

THE ANNUAL CONVENTION.

The local association at Kingston have made every arrangement for the entertainment of the delegates to the annual convention to be held in that city on the 18th and 19th inst. It is expected that about one hundred delegates will be present, and as Kingston is favorably situated for a summer meeting, a pleasant as well as a profitable time is assured.

Mayor Elliott has consented to deliver an address of welcome in the Council Chamber, after which a business session will be held. On the second day the delegates and their friends will sail down the river by special steamer, visiting some of the most picturesque islands of the St. Lawrence. Among other social features will be a drive to Fort Henry and around the Kingston Mills, a visit to the penitentiary and other places of interest, a lawn party at Ontario Park, and a banquet at the Hotel Frontenac on the evening of the last day, by the courtesy of the local association.

The business programme was not finally arranged at time of going to press, but it is expected that some interesting papers on engineering subjects will be presented, and other questions of interest to the association brought up for discussion.

The members of the Kingston association are working faithfully to ensure the success of the convention, and it is hoped their efforts will be rewarded by a large attendance of members.

A NOVEL INSTALLATION.

THE Royal Electric Company recently installed at Peterboro one of their synchronous motors to operate a stone crusher, used by Messrs. Corry & Laverdure, contractors for the construction of the Trent Valley Canal, to crush all stone required for that section of the canal.

The Peterboro Light and Power Company furnish the current operating this motor from their 180 kilowatt "S.K.C." generator recently obtained from the Royal Electric Company.

This plant is interesting because it is, we believe, the first of this kind and the only one in commercial operation in Canada, and because it indicates a useful, profitable and practical direction in which central stations can employ their plants during the period of the day when lighting is not required.

Mr. J. F. H. Wyse, representative of the Royal Electric Company, who directed the installation, spoke of it as follows: "The current to operate the stone crusher is transmitted from the station of the Peterboro Light and Power Company, a mile distant. The motor plant consists of a fifty kilowatt alternating current synchronous motor, with its exciter, and a five horse power starting motor. The alternating current is taken

by the motor directly from the transmission line at 1,000 volts. The stone crusher is belted to one end of the shaft of the synchronous motor, to the other end being belted in tandem the exciter and starting motor.

It was intended at first to use a shifting device or clutch arrangement to connect and put into operation the stone crusher after the synchronous motor had attained the required speed. This plan was changed, however, in order to simplify the arrangement, and the five horse power starting motor relied upon to bring up to speed the synchronous motor with stone crusher attached, as well as to drive the exciter.

Although this demanded more power than the rated capacity of the motor, it did the work with ease, and readily brought the synchronous motor to above the required speed.

To indicate to the attendant on the stone-crushing plant the proper time to connect the synchronous motor with the alternating current transmission line from the station of the Peterboro Electric Light and Power Company, a regular "S.K.C." synchronizer, as made by the Royal Electric Company, is used, which consists simply of two of their "2 C" Stanley transformers, so connected that when the synchronous motor is at the required speed and in step with the generator, a mile away, a lamp connected with these transformers goes out, giving positive indication to the attendant when to connect the motor with the transmission line.

The plant was started June 17th and the stone crusher has been successfully doing its work every day. It has been put to the utmost test; the greatest possible loads have been put on; the crusher has been jammed full of the hardest stones obtainable; the greatest variations possible in load, from nothing to the extreme capacity of the crusher, have taken place rapidly, but no variation in speed occurred, the synchronous motor meeting every demand upon it without change.

Messrs. Corry & Laverdure express themselves as more than pleased at the operation of the plant. They have also bought another motor from the Royal Electric Company to operate a pile driver.

THE VALUE OF ADVERTISING.

ONE of the largest advertisers in London says: "We once hit upon a novel expedient for ascertaining over what area our advertisements were read. We published a couple of half-column ads. in which we purposely misstated half a dozen historical facts. In less than a week we received between 300 and 400 letters from all parts of the country, from people wishing to know why on earth we kept such a consummate idiot, who knew so little about English history. The letters kept pouring in for three or four weeks. It was one of the best paying ads. we ever printed, but we did not repeat our experiment, because the one I refer to served its purpose. Our letters came from school-boys, girls, professors, clergymen, school-teachers and, in two instances, from eminent men who have a world-wide reputation. I was more impressed with the value of advertising from those two advertisements than I should have been by volumes of theories."—Exchange.

A second edition of the Inventor's Guide has been issued by Messrs. Ridout & Maybee, patent solicitors, Toronto. It has been considerably enlarged, and contains, in addition to other interesting features, a table containing economic statistics of the population, area, industries, etc., of the different countries of the world.

In re appeal of the New Westminster and Burrard Inlet Telephone Company, the Supreme Court of British Columbia held that telephone wires, whether carried above or underneath the soil of the highway, are liable to be taxed by the city of Vancouver. A switchboard is not a fixture and therefore not liable to be taxed.

SPARKS.

The Brantford Electric Light Company propose putting in a new plant.

Only one tender was received by the Toronto City Council for the telephone franchise for the city.

The employees of the Bell Telephone Company, Montreal, held their annual picnic on the 25th of July.

The town of Goderich has passed a by-law to introduce the incandescent system of electric lighting.

The Citizens' Light & Power Co., Cote St. Paul, Montreal, will build an addition to their engine house.

Mackay & Guest, of Renfrew, Ont., intend erecting an isolated water power plant and putting in another machine.

The City Council of St. Thomas, Ont., will submit a by-law to the ratepayers for the establishment of an electric light plant.

The Lachine Rapids Hydraulic and Land Company have been granted permission to increase their capital stock to \$2,000,000.

Judge Thos. Deacon has decided that the Bell Telephone Company at Annapolis must pay taxes on \$1,000 worth of real property.

A Chicago lawyer has defined a promoter as follows: "One who sells nothing for something to a man who thinks he is getting something for nothing."

Mr. Nicola Tesla is announced to have discovered a method of successfully transmitting electricity, upon a commercial basis, over a distance of at least 500 miles.

The Board of Governors of the Hamilton general hospital are considering the question of installing an electric light plant. An estimate for a plant of 250 lights places the cost at \$2,500.

It is said that the Lake Superior Power Company, of Sault Ste. Marie, Ont., will go extensively into the production of calcium carbide, the substance from which the new acetylene gas is manufactured.

Arthur Gagnon, a Bell telephone lineman, while working on one of the company's poles on McGill street, Montreal, came in contact with a live wire and fell forty feet to the ground, being instantly killed.

The city of Vancouver, B. C., recently made a contract for lighting the city at a cost of 27½ cents per night per lamp of 2,000 candle power. This is stated to be the lowest rate yet obtained by any city of less than 30,000 population.

Said the maiden, archly smiling:

"Why all this catholic fuss?

Men should know we've long seen through them,

But they'll never see through us."

—San Francisco Examiner.

The town of Trenton, Ont., has moved for an interim injunction to restrain the Trenton Electric Light Company from supplying electricity to persons outside the town and from using poles planted in the streets of the town for that purpose. The case will be heard at Cobourg in September.

Incorporation is announced of the Little Salmon River Telephone Company, for the purpose of constructing a telephone line between Sussex, Clover Hill, Waterford and Havelock, N. B. The promoters are Messrs. S. H. White, W. J. Mills, A. L. Price, C. J. Armstrong and H. B. Price, of Sussex.

The Toronto Street Railway Company have under consideration the construction of an electric road from Hamilton to Toronto. The road will, in all probability, be an extension of the present line to Long Branch. Mr. McCulloch, electrical engineer for the company, is making a survey of the route.

The Auburn Light and Power Company has been organized at Peterborough, Ont., and is applying for incorporation. The personnel of the company is Messrs. James McKendry, M.P., John Carnegie and W. H. Meldrum, manager. The object is stated to be to supply electricity for power and lighting purposes.

The town of Peterboro, Ont., recently asked tenders for electric street lighting. The Peterboro' Light and Power Company tendered at the following figures for 300 nights in the year: Two year's term, \$65.00 per light; three years, \$62.50; five years, \$57.50. The Auburn Light and Power Company tendered at \$75.00, \$73.50 and \$72.00 respectively. No action has as yet been taken by the council.

The Lachine Rapids Hydraulic & Land Co., of Montreal, having acquired the rights from the Standard Light & Power Company to place wires under ground in the city, have applied to the city council for permission to proceed with the work. The company propose to use cement lined iron tubes, similar to those used in many cities in the United States, and vitrified tile after the style of the Niagara Cataract Construction Company's plan, and for

sub-mains Edison's tubing, filled in with asphalt by hydraulic pressure.

A despatch from Chicago, dated July 27th, says: A combine has been formed for the purpose of maintaining prices, by the leading manufacturers of incandescent lamps in the United States. This agreement will practically put an end to the war in prices, which has virtually done away with all the profits in this line of business. The factories and corporations under the new combine are: The General Electric, the Bryan-Marsh Company, Columbia, Packard, Westinghouse, Buckeye, Sunbeam, Adams-Bagnall, Perkins, Bernstein, Beacon and Warren.

PERSONAL.

Mr. Wm. MacKenzie, President of the Toronto Railway Co., has just returned from England.

Mr. William Ahearn, jr., has been appointed manager of the Ottawa Porcelain and Carbon Co., vice Mr. J. W. Taylor, resigned.

Mr. L. B. McFarlane, of Montreal, has been appointed General Superintendent of the Bell Telephone Company of Canada.

Mr. H. B. Spencer, managing director of the Hull and Aylmer electric railway, has taken an office in the Central Chambers, Ottawa.

Mr. C. R. Hosmer, president and general manager of the C. P. R. Telegraph Company, has recently returned from a trip to England.

Mr. Harry Nuttall, financial secretary of Montreal No. 1 C.A.S.E., is at present in England paying a visit to his friends in his native land.

Mr. Geo. W. Sadler, of the well-known firm of Robin, Sadler & Haworth, has been elected as alderman to represent St. Antoine ward, Montreal.

Mr. De Hart, superintendent of the London, Ont., street railway, is said to have received an offer to manage a street railway in a large city in New Mexico.

Mr. C. J. Mullen, formerly electrician of the Ottawa Electric Railway Company, and who has recently been in South America, has arrived at Durban, South Africa.

Mr. Chas. Aird, inspector, and Mr. Geo. M. Seguin, cashier, of the Ottawa Electric Railway Co., have been appointed train master and accountant respectively for the Hull Electric Railway.

The death is announced in London on July 7th of Sir John Pender, one of the original promoters of the Atlantic cable, and prominently connected for 40 years past with sub-marine cable companies and enterprises. Sir John Pender had reached the advanced age of 80 years.

Mr. H. W. Kent, manager of the New Westminster and Burrard Inlet Telephone Company, was married on the 8th of July to Miss Florence Emily Findley, of Charlottetown, P. E. I. Mr. Kent is well known throughout the western province, having been connected with the establishment of a number of telephone systems.

Mr. Gordon J. Henderson, of Montreal, has been appointed manager of the Hamilton Electric Light and Power Co. Mr. Henderson is a brother of Mr. C. W. Henderson, electrical contractor, of Montreal. Mr. J. J. Wright, of Toronto, under whose management the company has been for some time past, has been appointed on the Board of Directors.

TRADE NOTES.

The W. A. Johnson Electric Co. have been awarded the contract for a 40 arc light dynamo for the electric plant at Toronto Junction.

The St. Johns Electric Co., St. Johns, Newfoundland, are making extensive additions to their plant. E. Leonard & Son, of London, are supplying the steam plant.

The Le Roi Mining Co., of Rossland, B. C., have placed an order with the Ingersoll Rock Drill Co., of Montreal, for a large direct-acting winding roll, 24 x 40, and for three 125 h.p. boilers.

The following is a partial list of motors installed by the Kay Electrical Mfg. Co. during the last month: Messrs. Buntin & Reid, Toronto, 4 h.p. motor; Central Press Agency Co., Toronto, one electrolyzing dynamo; Linden Creamery Co., Toronto, one 5 h.p. motor; Wherle Brush Co., Toronto, one 5 h.p. motor; Mr. Hutchison, wood yard, Toronto, 10 h.p. motor; Steel-Clad Bath & Metal Co., Toronto, one electrolyzing dynamo and one 1 h.p. 4-pole motor; Mr. A. Moore, Toronto, one 2 h.p. motor; Mr. Woods, printer, Toronto, one 2 h.p. motor; Kemp Mfg. Co., Toronto, two 6 h.p. motors; McLean Publishing Co., Toronto, one 6 h.p. motor; Mr. R. Lindman, Toronto, one 2 h.p. motor; Mr. H. R. Cuddon, St. Catharines, one 3 h.p. motor; Mr. G. C. Hinton, Victoria, B. C., one 3 h.p. motor and one 6 h.p. motor.

ELECTRIC RAILWAY DEPARTMENT.

NEW RAILROAD MOTOR.

A TEST of a new electric motor, the invention of Mr. Nicola Tesla, will shortly be made at the works of the Westinghouse Company in Pittsburgh. The motor is destined for use on the elevated railways in Boston, and is a polyphase or induction motor, applying an alternating current, which is said to be preferable for long-distance transmission. Its distinctive characteristic is the utilization of the rotating magnetic field. It does away with the commutator and the brush, necessary to the use of the direct currents in action. Mr. Tesla states that the discarding of these makes his motor less costly—an important consideration—more reliable, easier to handle, and less perilous to those who handle it.

THE HURON AND ONTARIO ELECTRIC RAILWAY.

THE Huron and Ontario Electric Railway Company are slowly but steadily completing arrangements for the construction of the road. According to the act of incorporation, the capital stock of the company is to be two million dollars. Mr. N. McNamara, of Walkerton, is president, Dr. Rollston, of Shelburne, vice-president, and Mr. A. McK. Cameron, of Meaford, secretary. The road will extend from Port Perry to Kincardine, with two branches, one running north from Priceville, through Meaford, Owen Sound, Tiverton, etc., around to Kincardine, and the other extending from Walkerton, through Mildmay, Teeswater, and Lucknow to Goderich, with a connection between Lucknow and Kincardine through Ripley. The entire length of the road will be something over 300 miles, and motive power for its operation will be supplied from stations at Eugenia, Glen Roden, Southampton and Thompsonville.

The company is authorized to issue bonds to the extent of \$10,000 per mile for construction purposes, and \$6,000 additional for each mile double-tracked. At a meeting of the shareholders held in Toronto recently an offer for construction was received from a New York firm. It was stated that most of the municipalities interested had passed resolutions adopting the by-laws and agreements with the company. A survey of the route is now being made by engineers. This will occupy about two months, after which track-laying will be proceeded with.

In Chemnitz, Saxony, no poles are used for operating the electric street railway. The method of stringing wires is by means of ornamental rosettes fastened into the woodwork or walls of houses, having projecting hooks to which the wires are attached. These hooks are firmly fastened and are tested with seven times the weight they are called upon to bear. The railway tracks are level with the pavements, and accidents are rare. The cars run at a rate of 220 yards a minute in the centre of the city. No conductors are employed, the motorman being the only person on board who represents the company. By doing away with conductors the company saves 44,000 marks annually. The fare is only 10 pfennigs, or a trifle less than $2\frac{1}{2}$ cents, on all routes, including transfers. Should 150,000 persons evade payment in 12 months, the loss would be only 15,000 marks. It would take 450,000 evasions in fare to offset the company's savings by dispensing with conductor's salaries. Fare boxes are attached to both ends of the car.

SPARKS.

George Beattie was killed by a trolley car on the Hull & Aylmer electric railway.

A. W. Prestine, a carpenter of Hespeler, Ont., was killed on the Galt, Preston & Hespeler street railway by falling between the motor car and trailer.

An exhibition of Reynold's self-loading electric car was given in Montreal recently under the supervision of Mr. St. George, City Surveyor. The work done was satisfactory.

In lieu of privileges granted by the city of Hull, Que., the Hull and Aylmer Electric Railway Company have agreed to light the city for five years with thirty-two candle-power lamps.

Arrangements are being made in St. Johns, Nfld., for the construction of an electric railway, to operate between the city and suburban villages within a distance of twenty miles. The plant will be driven by water power.

The Canadian Electric Railway and Power Co. is seeking power from the Dominion Government to build an electric railway from Cobourg via Port Hope, Bowmanville, Oshawa, Whitby, Toronto, Oakville and Hamilton to Suspension Bridge and Niagara Falls.

The Vancouver, Victoria and Eastern Railway and Navigation Company is applying for incorporation to construct telegraph and telephone systems along the line of a proposed railway from Vancouver, B. C., through Manitoba, Ontario and Quebec to the Atlantic seaboard. The solicitor for the company is Donald G. Macdonell, of Vancouver.

Experiments have recently been conducted in New York by the New York Central Railroad Company, with a new hot water motor. The hot water, under enormous pressure, is stored in supply boilers and then charged into the battery cylinders of the motor. The great merit of the motor is said to be its cheapness. The cars can be operated upon any track, all that is required being a number of boiler houses along the road.

An effort is being made by the citizens of Cote des Neiges to compel the Montreal Street Railway Company to extend their line along Grey street and up Cote des Neiges Hill. The company object to building the line up the hill on the grounds that there is little traffic and the danger to life would be very great. The matter has been referred to the city attorney, with the object of learning who is the competent authority to determine where lines should be built in accordance with the terms of the franchise.

The belt line railway around Toronto which was constructed some years ago by the Grand Trunk Railway Company did not prove a paying investment, and has not been operated for some time. A company is now being formed, to be known as the Toronto Radial Railway Company, to acquire the property and franchise of the said railway, with the object of electrifying the road, and with the privilege of making extensions within a radius of fifty miles. Messrs. Dewart & Raney, Toronto, are solicitors for the company.

The directors of the proposed Carp, Almonte and Lanark Railway held a meeting on Wednesday last, when it was decided to begin preliminary surveys at once. It is proposed to have the line run from Carp to Bridgewater, a distance of some 68 miles, passing through Almonte and Lanark. From Bridgewater the line will connect with the Central Ontario R. R. and the Grand Trunk. Among the promoters are Mr. T. W. Rains, president, and Messrs. W. H. Stafford, D. M. Fraser, D. Shaw, Dr. Groves and J. W. McElroy.

The Ottawa Electric Railway Company provide amusements for their patrons at the parks owned by the company adjacent to the city. On the 22nd ultimo an exhibition of Edison's latest invention, the Vitascopie, was given at "West End" park. The Vitascopie is an improvement on the Kinetoscope, and instead of objects being reproduced in miniature in a cabinet, they are thrown in life size on a large screen, just the same as lime-light views. A view of Prospect Park, Brooklyn, showing foot passengers, bicyclists and horses passing, was an interesting feature, as was also the breakwater at Coney Island.

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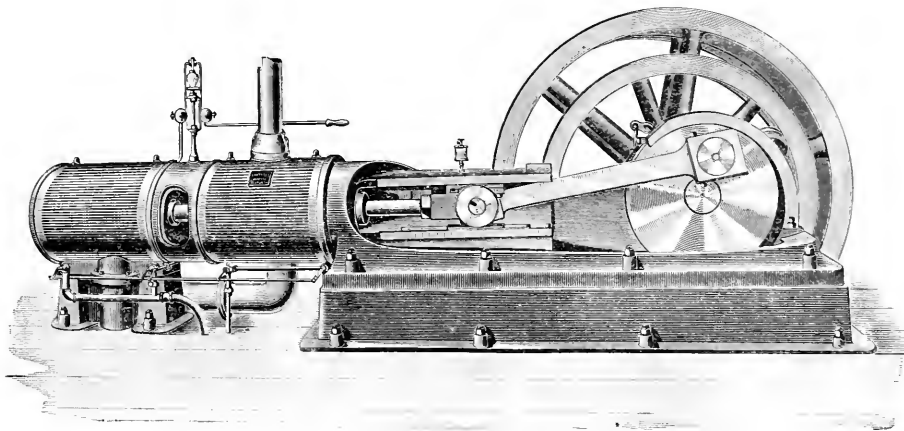
SEPTEMBER, 1896

No. 9.

TANDEM COMPOUND STEAM ENGINE.

THOSE who have observed the trend of steam engine designing during the past few years will have noticed that there is a tendency towards a short, compact, heavy built frame, with strong simple parts, suited to the severe and incessant work imposed upon power plants by street railway and other heavy work. Corliss and other types of long stroke engines have been shortened and strengthened in order to meet these conditions and to occupy less room, and there is also a tendency to increase the speed to suit direct driven dynamos and give better regulation. In fact, there seems a tendency for the advocates of high and low speed to meet half

is of the "Sweet" or "Straight Line" pattern, used in all engines made by the Robb Co., is of the simplest and most sensitive form and directly connected to the valves. The high pressure cylinder is placed next to the frame, low pressure in rear, and so arranged that the cylinder head and pistons may be removed without disturbing the cylinders, valves or other parts. The valves are of the "Porter" type, consisting of a flat plate balanced by a pressure plate, which have proved so successful in the "Porter-Allen," "Straight Line" and other engines, their greatest merit being simplicity and freedom from wear. Both high and low pressure valves are attached to the governor in such a way as to



TANDEM COMPOUND STEAM ENGINE.

way in a type of engine which will embody the best points of each.

As an example of what is being done in this way, we give an illustration of a tandem compound engine, built by the Robb Engineering Co., of Amherst, Nova Scotia. The cut is from one of four engines of 300 h. p. each recently installed for the Halifax Electric Tramway Co. for railway and lighting purposes, and it represents a type of engine designed with a view to combine the best points of long and short stroke engines.

The design of frame and general proportion of parts is similar to recent types of long and medium stroke engines designed for railway work. The shaft bearings, crank and crosshead pins are much larger than usual, to insure cool running under stress of overloading or irregular work. The guides are cylindrical, allowing the crosshead free alignment. The disc crank contains sufficient metal to permit the crank pin and shaft to be forced in under heavy hydraulic pressure, and is balanced. The main journal has quarter boxes with adjustment at top and sides. The governor, which

divide the load exactly between the high and low pressure cylinders. This system is new and peculiar to the Robb engines and is found to give better economy with variable loads, such as are found in railway work.

The manufacturers are now building a full line of these engines, in simple, tandem and cross-compounds, up to 700 h. p., having a medium length of stroke, speed from 150 to 200 revolutions per minute; and as the parts are massive, and bearings unusually large, parts simple and strong, they are splendidly adapted for direct connection to electric generators or other variable work.

The extension of the Hamilton, Grimsby and Beamsville railway to Beamsville will shortly be completed.

The number of miles possible to be ridden in the United States on a street car for five cents is said to range from $8\frac{1}{4}$ miles in Jersey City up to 18 miles in Brooklyn, the average of ten cities being 13 miles. At Chicago a ride of 21 miles can be had for this small sum on an ordinary railroad.

THE HAMILTON ELECTRIC LIGHT AND POWER COMPANY.

ONE of the best equipped electric light and power plants of Ontario is that of the above company. The plant began operations in April, 1892. It occupies two buildings. The dynamo room was designed and constructed under the direction of Mr. D. Thomson, the late manager. The placing of the machinery was directed by Mr. Dickinson, chief engineer. The dynamo building, on Main St., is 135 x 70 ft. with hip roof, supported by wooden beams covered with corrugated iron; a cupola surmounts the top. The stone foundation is laid in Portland cement and sharp sand.

Two pair of "Brown" (Polson Works) engines of 700 h. p. each, 78 revolutions per minute, 22 inch cylinder, 50 inch stroke, with fly wheel 16 x 4 ft., and one high speed compound engine of 150 h. p., 250 revolutions per minute, all non-condensing, drive the 120 feet



MR. GORDON J. HENDERSON,
Manager Hamilton Electric Light and Power Company.

of line shafting, $5\frac{1}{2}$ inches in diameter, and 7 inches at driven pulleys, which runs down the centre of the building between the engines and the machines. A Leonard-Ball engine is also in place, but is not used. These engines are belted to the shafting by 4 foot 3 ply Robin, Sadler & Haworth belting. A Bain & Coville clutch coupling is in the centre of the shafting. The fly wheels are boxed in casings next the passage between them and the wall. At the rear wall are two Northey pumps, 8 inch cylinder, 12 inch stroke, and 5 inch rams, pumping water at 208 into the boilers from a heater built by Bain & Coville from a design by the chief engineer. The different compartments of the heater are full of hay. The hot water passes through this hay, which extracts the lime and magnesia from the water, which forms in a hard lime-stoney substance on top of the hay.

Entering the rear wall on a level with the cross beams are two 10 inch wrought iron steam mains conveying steam to the several engines. The branch pipes are 6 inches. Where the mains enter the building are three 10-inch valves and a pipe connection between the mains. The valves work so that both mains can supply the engines, or all the engines run from one main.

The floor is concrete except one spot, which is of wood and underneath which is a large tank containing 7,000 gallons of water, to be used in case the water mains give out.

The machines consist of arc and incandescent lighters and electric power generators. There are two "Royal" alternators with exciters, (one of 2,000 lights and the other of 1,250 lights), one "C. G. E." 2,000 lighter and exciter, and one Westinghouse 1,800 lighter and exciter. Fifteen machines of varying power supply arc light, fourteen of which are from the Royal Company; the other, of 35 lights, being a Toronto Electric Light machine. The Royal arcs are as follows: four 35 lighters, eight 50 lighters, and two 12 lighters. An "Edison" 75 K. W. generator and a "Royal" 100 K. W. multipolar generator generate power for motors of from $\frac{1}{2}$ to 15 h. p.

The machines are set on stone foundations, 5 feet

deep, and run very smooth. Mr. Martin, the chief electrician, has his office to the right; behind this is the store room, where are all kinds of supplies and repairs for arc or incandescent lighting and installing of same. They use Packard lamps and Royal arcs, and Ottawa and C. G. E. 58 carbons. The repair shop and lamp testing room is 20 x 25 feet. A full equipment for all repairs is in this shop, except for heavy machines, which are wound by the Toronto Electric Light Co. Along the wall of the store room is the large slate switch board with full complement of instruments for the alternators and generators. On the arc switch board are 14 circuits and on each circuit is an automatic pilot light. In case of the opening of a circuit or trouble at the machine, the pilot light supplied from an incandescent circuit lights up and the operator can see at a glance what circuit or machine is in trouble. This is the invention of Mr. Martin, the chief electrician.

On the arc poles the lamps are hung on hinged arms, no drop ropes being used. Each trimmer is given 90 lamps a day to trim and he covers his circuit with a horse and two wheeled "chariot," which was designed by the chief electrician.

On King street is a three-storey structure in front, combining the offices of the company, and several other offices. The rear is taken up by the boiler room. There are three batteries, the first comprising five 60-inch Osborne-Killey tubulars, 75 h. p. each, and the second two, 66 inch Goldie & McCulloch tubulars, 90 h. p. each; and two Polson water tube boilers, 200 h. p. each. All these boilers are connected to a square brick smoke stack 125 feet high. The tubular boilers are connected to one main and the water tube boilers to the other.

The fuel used under these boilers is hard and soft coal screenings, three-fifths being soft coal. Between the two buildings is a space of about ten feet, and the coal as it passes through is weighed on scales operated from the chief engineer's office, which is in the rear corner of the dynamo room. The engines in the dynamo room exhaust under the floor through a 12-inch pipe, which passes into the rear building 3 feet underground



MR. T. W. MARTIN,
Chief Electrician Hamilton Electric Light and Power Company.

in a box of sawdust. The steam mains carried between the buildings are covered with 12 inches of mineral wool with box castings.

The city use 375 arc lights, and 75 arcs are in commercial service. The capacity is 500 lights. Over 9000 incandescent lamps are installed and on an average 300 new lamps are installed each month.

The directorate of the above company and of the Toronto Electric Light Company being largely the same, Mr. J. J. Wright, manager of the latter company, assumed the management upon the resignation of Mr. Thomson about two years ago. Since the amalgamation of the Toronto Electric Light Company and the Incandescent Light Company in Toronto, however, the duties of Mr. Wright have been so onerous that it has been found necessary to appoint a separate manager for the Hamilton company. The appointment has been given to Mr. Gordon J. Henderson, of Montreal.

Mr. Gordon J. Henderson, who has recently been appointed manager of the company, and whose portrait is herewith presented, was born in the city of Montreal in the year 1872. He is a son of Mr. David H. Henderson, a prominent lumber merchant. For some years he has been connected with his brother, Mr. C. W. Henderson, the well-known electrical contractor of that city. He is quite prominent in Montreal's society, and holds a commission as Captain in the 6th Battalion Fusiliers, having the honor of turning out the best drilled company in his battalion. Mr. Henderson is a business man of considerable ability, and under his supervision the company will no doubt enjoy a marked degree of prosperity.

Mr. T. W. Martin, chief electrician, was born in London, England, 26 years ago. His family came to Canada, and at the age of fourteen years he entered the employ of the Toronto Electric Light Company, under Mr. Wright, in the old Sherbourne street plant. He was removed to Hamilton two years ago. He is a



MR. R. DICKENSON,

Chief Engineer Hamilton Electric Light and Power Company.

clever electrician and fills his position in a creditable manner.

Mr. R. Dickenson, chief engineer, was born in Dover, Kent, in 1841. He entered the Royal Navy in 1858, in which he served for some years, leaving it for merchant vessels. In 1874 he came to Canada, filling different positions, and eleven years ago he entered the employ of the Hamilton Electric Light Co.

THE PARAGON OF EXHIBITIONS.

THE major part of the entries having now been made for Toronto's big exhibition, which is to be held from August 31st to September 12th, it is possible to state definitely that the scale of the exhibition will really be greater than ever. Never before did the exhibits cover such a wide range as they will this year. It almost looks as if every province had striven to do its best to make the exhibition worthy of the country. At the forthcoming exhibition in Toronto there will be seen food products of Prince Edward Island; food products, manufactures, fruit and live stock, of Nova Scotia and New Brunswick; an extensive display of horses and cattle, manufactures and minerals, from Quebec; the products of forests, waters, mines, gardens, farms, studs, workshops and art studios of Ontario; the grain, minerals and horses of Manitoba; the grain and minerals of the North-West; and cereals, fish and minerals of British Columbia. The governments of Ontario, the Dominion and British Columbia will make special exhibits of the wealth of the earth, while the Canadian Pacific Railway will supplement these displays by showing cereals, vegetables and minerals from many points on their lines, to the extent of double what the company has shown in other years. In art especially will the exhibition be strong, with the three pictures painted by F. M. Bell-Smith, illustrating incidents connected with the death of Sir John Thompson, at Windsor Castle, for one of which pictures Her Majesty the Queen, Princess Beatrice and members of the Royal household gave special sittings. There will be Edison's wonderful Eidoloscope, an electric theatre; Ontario Trotting Horse Breeders' stake races; Lockhart's performing elephants; the magnificent historical spectacle, entitled the "Feast of Nations" and commemorating the "Taking of the Bastille," and a thousand and one other things; while in consideration of the cattle being on show the first week the railways have agreed to grant one fare for the round trip for the entire exhibition from all points in Canada, and to run a special cheap excursion the first week, on Sept. 3rd, and two the second week.

TRANSFORMERS.

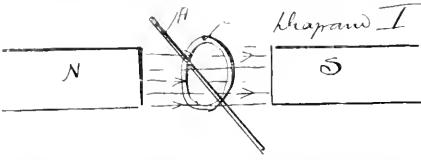
By G. W. F.

THE really distinctive feature of an alternating current system is the transformer. Without it the alternating current would possess no advantages over the direct, and the transmission of power for lighting or motor purposes would be impracticable except at the cost of very large conductors. The use of the alternating current in connection with station transformers arose out of the practical limitations imposed on direct current apparatus, and in so far as an improvement in the art. In direct current working the pressure generated by the dynamo is maintained throughout the entire system; a 220 volt machine will cause a pressure of 220 volts (less the "drop" of course) between the positive and negative wires at all points; a 500 volt machine gives a pressure of 500 volts everywhere, and so on. In order to distribute current over an extensive area, it is evidently necessary to use either heavy, and therefore expensive, feeders with a 220 volt pressure, or to use a higher pressure and so allow of smaller feeders. But as it is not at all desirable to introduce a high pressure into lamps placed in private buildings, where they have to be handled constantly, and where the wires are frequently exposed to risk of grounding, it is evident that a limit of pressure is soon reached, and that any extension of business must be met by an additional expenditure for feeder copper. In a district where there is a large amount of lighting this may be commercially possible, but it is quite easy to imagine conditions where the additional amount of lighting would not actually justify the necessary feeder expense. It is easily seen that any method which permits of the use of a high pressure for transmission, and at the same time of a low pressure for utilization, meets the conditions of economical supply and safe use. The static transformer renders possible an advantage beyond the power of the direct current.

It would be strange if a piece of apparatus possessing such great importance were not worth capable study, and in fact the electrical principles governing its action, and the electrical, magnetic, and mechanical features entering into and influencing its design and construction are not merely of great interest, but a thorough comprehension of them is necessary before the constructing or operating electrician can be considered conversant with alternate current working. To the casual observer a transformer is merely a quantity of insulated copper wire wound in two separate coils round an iron core; the whole placed inside a box and what goes on inside that box when the current is turned on is of no more interest to them than the mechanism of a musical box—you turn the handle and grind out music; you turn on the current and you get light somehow. It is thought by those whose interest in electrical matters leads them no further than the study of how to pay the least money for plant—that once a transformer is hung up on a pole and connected into circuit there is the end of it; that the worst thing that can happen to it is to have one of its fuses blow, or lightning get into it and burn it up. As to its being a source of expense all the time, as to its capacity for wasting current, the matter not only does not occur to them, but they actually smile when it is suggested to them. How can a transformer be a source of expense? How can it waste current? It isn't doing anything; it isn't moving or revolving; there's no friction about it—it doesn't need oiling might as well suggest that a glass insulator is a source of expense. A little investigation, however, will show that the transformer is not the simple thing it is popularly supposed to be, and that careful study and educated thought were just as necessary in its evolution as introducing the high class modern dynamo. The basis of transformer action is the same as that of dynamo action—induction. If a closed conductor be placed in a magnetic field, the intensity of which is rapidly varying, an E. M. F. is set up in that conductor, the direction of the E. M. F. will depend on whether the intensity is increasing or decreasing its strength on the rate of variation.

N S are two poles, the space between them being a

magnetic field as indicated by arrows. C is a closed conducting ring capable of being revolved on A , as axis. It is understood that A is really at right angles to the direction $N S$, and that the plane of the ring C is perpendicular to the direction of the lines of force from N



to S . Now if the strength of the magnetic field $N S$ is always the same (as it generally is in a dynamo) and if the ring C be held stationary in any position, it will be evident that nothing is varying, and consequently there will be no current set up in C . But if we now revolve the axis A (in either direction) and with it the ring C , it will be seen that, although the same amount of lines of force will always flow from N to S , the ring will in some positions hold less of them than it will in others. In the diagram No. 1 the ring is perpendicular to the field and will contain say X lines of force. In diagram No. 2, having now revolved it through a quarter of a

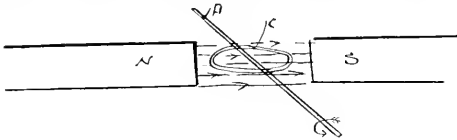
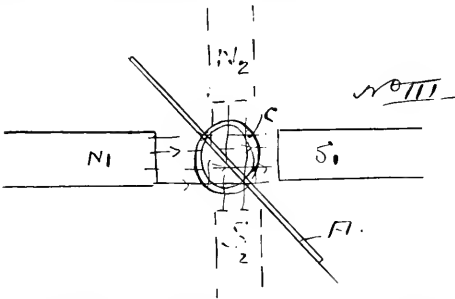


DIAGRAM II.

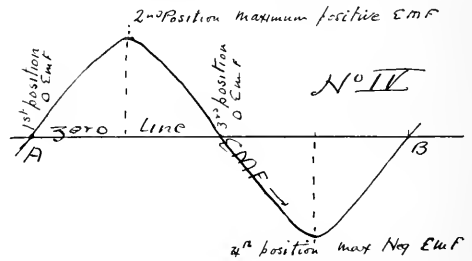
circle, the plane of the ring is parallel to the lines of force, and contains none of them at all.

So that in the course of a quarter revolution we have varied the lines of force contained by the ring from a certain maximum down to nothing, and this is the condition necessary for the setting up in the ring of an electromotive force. Turning C through another quarter circle would again vary the field with respect to the ring from nothing up to the same maximum as before; the third quarter turn would bring it back to nothing; the fourth raise it again to the first position. Thus, revolving the ring in a constant magnetic field, causes a variation with respect to the ring which sets up an E. M. F. in it. The same result would be obtained by holding the ring stationary and causing the field to revolve, as indicated in diagram No. 3.



The ring C is perpendicular to field $N_1 S_1$, and if these poles be shifted to positions $N_2 S_2$, the ring being not moved; the ring will be parallel to the new field $N_2 S_2$, hence during the shifting of the positions of the poles an E. M. F. will have been set up in C . It is therefore evident that so long as there is relative movement, it does not matter whether the ring be moved or the field. The necessary condition being a varying of the lines of force passing through the ring, a third method is possible which will attain that object without revolving either the ring or the poles. It in the above diagrams the poles N and S are supposed to be electro magnets, (that is iron bars which are made magnets by the passage around them of a current), and we have some means of varying the current passing through the wire,

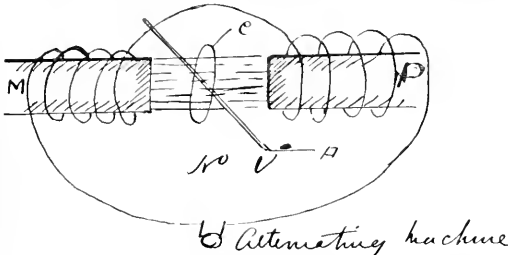
either by means of a rheostat or other equivalent means, then, remembering that the strength of an electro-magnet (the strength of its field) varies within certain limits, in the same proportion as the current producing it, it will be evident that the field can be varied up or down by simply turning the rheostat, leaving both poles and ring stationary. And from this last method it is but a step to the energizing of the poles by an alternating current which will cause an even greater variation of the field than the rheostat can accomplish with a direct current. This will be plain when it is considered that the current in an alternating circuit begins at nothing, grows rapidly to a certain maximum, diminishes again down to nothing, then actually changes its direction and grows to a negative maximum, and then decreases again to nothing. Turning to diagram No. 1, we will suppose ring C to be one of the coils of an alternating dynamo. In the position where C is perpendicular to the lines of force $N S$, any very slight revolving of A will not vary the amount of them contained by C much; in fact in this position a slight revolving will really generate no E. M. F. at all, but as A is revolved (counter clockwise) ring C will hold less and less lines of force until it reaches the position in diagram 2, when the rate at which C is decreasing is greatest, and as the E. M. F. generated depends on the rate of variation, the highest E. M. F. generated in C will be when it is passing through the position in diagram 2, and a proportionate E. M. F. will be generated in C at any intermediate position. So that the E. M. F. will grow during a quarter revolution from 0 to a maximum. When C has been revolved through a half turn, conditions will be as they were in diagram No. 1, and at this point no



E. M. F. will be generated in C , it having decreased from the position of maximum E. M. F. in diagram 2. If C be revolved through and then quarter turn, then everything will be the same as in diagram No. 2, and the E. M. F. will again be at a maximum, except that the direction of the E. M. F. has reversed, and instead of being from right to left is now from left to right; or, if we call the first direction positive we can call the new one negative. From the third quarter revolution to the fourth brings C back to the first position. All these changes can be put into a diagram form as in No. 4, where the curved line shows how the E. M. F. in the ring varies between a positive and a negative maximum. It will be understood that whereas the direction of the E. M. F. is from right to left in the upper part of the diagram, it becomes from left to right in the lower; the strength of the E. M. F. at any point in the revolution being indicated by the height of the curve above the zero line and the distance AB representing one revolution of the axis.

Now suppose we have two magnets M, P , energized by an alternating current as above, so that they shall be of opposite polarities and a ring C . From position 1 to position 2 (diagram 4) M will have a north pole, and P a south pole, constantly increasing in strength, and from position 2 to position 3 the polarities will be the same, but the strength of the field will diminish constantly back to nothing. At position 3, however, the direction of the E. M. F. changes so that, from 3 to 4, M will become a south pole (instead of a north), and P will now be a north pole (instead of a south), and the strength of this reversed field will constantly increase to a maximum at 4, and thence down to nothing at position 1, when the E. M. F. again changes its direction,

and the poles consequently again change sign. During these variations and reversals, the ring C will (although stationary) have been placed in a varying field produced by the alternating electromagnets, and consequently an alternating E. M. F. will have been induced in C. This is the simple theory on which is based the action of the transformer, but its application gives rise to phenomena which introduce new and less simple considerations. A transformer could be constructed on the plan shown in the diagrams, but a more convenient, and in every way



better form is adopted in practice. The simplest form may be shown in diagram where A is a bar of iron, P is an insulated wire wound round and carrying an alternating current from the generator G, S being another insulated wire also wound round A and P, (but insulated from both) and leading to say the lamp L. On passing the alternating current from G round A, the bar is at once made an electromagnet, the poles of which reverse their sign as the direction of the alternating current reverses. The whole space surrounding A becomes a magnetic field, the lines of force radiating in the manner

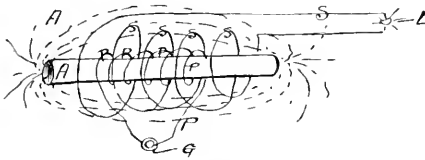


DIAGRAM VI.

indicated from one pole to the other. It is evident that under these conditions the coil S is just as much placed in a varying magnetic field as it was in diagram No. 5; hence a current will be induced in it. All transformers are built in this way: two coils wound together round a magnetic circuit, and insulated both from it and from each other, the one carrying the energizing current called the primary, the other in which current is induced called the secondary. The feature of special importance in this induction is that, no matter what may be the voltage in the primary coil, we can get what voltage we desire in the secondary, so that we can run our alternator at 1,000 or 2,000 or 5,000 volts, and still have only 52, or 104, or any other desired voltage in our secondary coils. This, of course, permits of the use of high voltage for distribution and low voltage at lamps, obtaining both economy and safety. The difference in voltage between primary and secondary wires depends directly on the proportion between the number of primary and secondary coils. If there be ten turns of the primary to each secondary turn, then the secondary voltage will be only one-tenth of the primary, and so on.

The action of the transformer is, as described above, that when the primary circuit is closed round the bar the alternating current transforms it into an electromagnet, with rapidly reversing polarity, and the varying and reversing field induces an alternating current of the same periodicity in the secondary wire. This appears to be so simple a process that the person who does not examine it more closely will not easily believe when told that a transformer wastes coal. As a fact, however, every transformer built—even the very best—necessarily wastes energy; good transformers waste less than second-rate ones. These wastes have been located and can be calculated. They result as follows:

On closing the circuit in the primary the core becomes

an electromagnet, whose polarity reverses at the same times as the current reverses. It has been observed that subjecting iron to an alternating magnetomotive force raises the temperature of the iron and this phenomenon has been accounted for by the following theory: Consider a bar of iron M. Pass a current round it from the source K in the direction of the arrow. Instantly the one end becomes a north pole N, and the other a south pole S. Now we may consider the bar to be made up of an infinite number of small atoms of iron pivoted at their centre points, each of which becomes a little atomic magnet, their N poles all pointing to the N end of bar, and their S poles all pointing toward the S end. Now reverse the direction of the current from K. Instantly everything is changed. The old north pole now becomes a south pole; the old south pole is now a north pole. Every little atomic magnet has swung round, and is now pointing in the opposite direction to what it did before. Plainly they cannot have done all

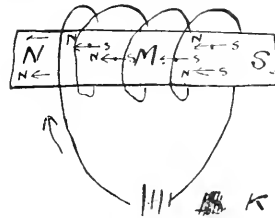
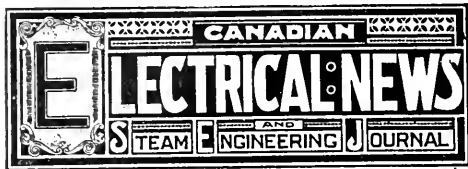


DIAGRAM VII.

this swinging without rubbing against each other and getting warm, and this friction requires a little expenditure of energy to overcome it. We can easily see, therefore, that a certain amount of energy is expended in the iron core of the transformer itself in producing the necessary alternating magnetism; and this energy will be greater in proportion as the number of reversals of the current becomes greater. It is also evident that as the number of atomic magnets increases—that is, as the total mass of the bar increases—a greater power must be expended in overcoming their friction; it will take twice as much power to swing 2,000 atomic magnets as to swing 1,000. Once more, it is evident that as the strength with which each atomic magnet points in one direction increases, i.e., as the strength of the magnet increases so will it take more and more power to force it to point in the opposite direction. Consequently, it is plain that a certain amount of power must necessarily be expended in the transformer itself in producing the alternating magnetism, and the actual amount of power so expended depends first on the number of times the current alternates; next on the number of atomic magnets to be reversed (that is the size of the whole iron bar), and third on the strength of the magnet (the amount of magnetic flux). It depends on the transformer itself whether the total amount of energy expended in this way is greater or smaller, but in any case it has to be supplied by the primary current and hence by the coal pile. It therefore follows that any means of reducing it is an advantage. The amount so expended depends, we have seen, on the number of reversals, the total mass, and the magnetic induction. It would therefore be an advantage to use a lower alternation, but this is limited by considerations outside the purpose of this article. It certainly will be of advantage to use a smaller bar of iron, but as in order to construct a transformer capable of giving a certain secondary voltage, we have to use a proportionate magnetic induction, the only way he can reduce the size of the iron is by using a better class metal whose permeability is higher. It is necessary to remember that bars of different kinds and qualities of iron will not give the same magnetic strength for the same current, but that the poorer the iron the less need be the magnetising current to give a desired strength. Consequently we can only reduce the mass by using a better quality of iron. Better quality means higher price—it is no economy to select the cheapest transformer.

To be Continued.)



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The C. A. S. E. report of the proceedings of the annual convention of the Canadian Association

of Stationary Engineers held at Kingston. A perusal of the report leads to the conviction that in point of attendance and also as regards the importance of the discussions and business transacted, this convention suffers by comparison with those of previous years. Our truest friends are those who sometimes call us to account for our shortcomings, as well as commend us for what is meritorious in our conduct. We trust, therefore, that the Association will not take it amiss if we give expression to a few opinions with regard to its policy and work. The avowed object of the Association, viz., to educate its members up to a higher standard of efficiency, thereby fitting them to improve their social and financial standing, is one which must commend itself to everyone. It appears to us, however, that this object is in some degree being lost sight of, as witness the fact that at the recent convention only one paper, and that upon a subject not intimately connected with engineering practice, was presented. There was practically no discussion whatever upon engineering practice—the subject above all others in which members of the Association are interested, and on which they need enlightenment. A large proportion of the time of the delegates was taken up with sight-seeing, and most of the remainder in considering ways and means of raising the revenue, which appears to be on the decline. Might not the energy which is being dissipated on publishing schemes, which are entirely without the province of the Association, and not calculated to enhance the respect in which it should be held by manufacturers and the public generally, be more profitably employed in the collection and dissemination of engineering knowledge of a character which should result in permanently increasing the membership and the finances? However this may be, the ultimate success of the Association will depend on the extent to which the desire for a pleasant outing is subordinated to a determination to promote the education and welfare of every member.

Operating Lamps at High Pressure.

THERE is a growing feeling in favor of operating lamps at a pressure of 220 volts instead of, as heretofore, at 110. Reports from Europe show that this method of distribution is rapidly gaining favor, and in the States there are quite a number of plants adopting the improvement. It will be obvious that the advantages of this are that a very considerably greater area can be served from the same station with the same loss, and that the percentage of variation of voltage will be very much less than it was with the 110 volts. This again reacts on the

lamps, so that their average life is greatly increased. The only matter that seems to retard the full development of the 220 volt distribution system seems to be the difficulty of producing good commercial lamps to suit the high pressure, and this seems to be in a fair way to being overcome. We recommend central stations to keep their eyes on this development, with the view of adopting it ultimately.

Designing an Electric Plant.

No part of the designing engineer's duty, when laying out a power house for electric lighting or railway purposes, is more important, or requires greater care and experience, than the general proportioning of the various pieces of apparatus and machinery, so that they may work together with the highest ultimate efficiency. Nothing is more apparent in the large proportion of lighting stations in the Dominion, than the complete absence of any continuous, coherent scheme, binding together and running through the entire plant, and we are sorry to say that nothing could be more unanimous than the complaint from those owning such plants, that electric lighting is not a very lucrative business. And yet very little consideration will show that these unfortunate results are but a necessary consequence of the policy—or rather the lack of policy—adopted by owners. It is too usual to consider a power house as consisting of two separate portions—steam plant and electric plant—and to consider them without much reference to each other. The purchaser is told that, generally speaking, it takes 10 lamps to a horse power, and on this very approximate and unsatisfactory basis he proceeds to make his own arrangements for steam engine, without having any idea as to the efficiency of the dynamo he proposes to try, or as to the most economical voltage drop, whether 5 or 10, or as to the many other data which would all greatly influence the proper power of the engine. As a matter of fact he places himself entirely in the hands of the engine builders, who certainly cannot be expected to be extremely well posted on electrical matters, and as both he and they are very insufficiently informed as to what power would be actually required, the chances are that between them they decide—"in order to be certain"—on an engine 25% larger than there was any necessity for. Now it is well to be on the safe side, undoubtedly; but then what is enough is enough—any more is a superfluity; and there is great likelihood that had advice been obtained from some independent engineer of competence the saving in the size of the engine would more than pay his fees. If it were only the question of saving a few dollars on the price of the engine, this would be not of sufficient importance to warrant any great extra expense, but such unnecessary extra horse power means a continual yearly extra and unnecessary expense for fuel, over and above what would be necessary with an engine of proper size. This will be perfectly evident when one considers that it takes an appreciable percentage of the power of engine to merely turn itself over without any load. This percentage is frequently placed at 10%; so that a 100 h. p. engine would take 10 h. p. to turn it over. Now on the supposition that an engine has been purchased that is larger than necessary, it is very easily demonstrated that each horse power of such unnecessary extra size will cost the central station, on the average, one-half ton of coal per year more than necessary, assuming such a low coal consumption as

3 lbs. per h. p. h. This may seem a small amount, but then it is unnecessary, and capitalized at 5% per annum, it represents a sum of \$40 per h. p. Then there is the further consideration of the less average efficiency of the larger engine working on a load only sufficient for a smaller one. What would be a full load for a 100 h. p. engine is only 80% of a full load for one of 125 h. p., and as the percentage efficiency of steam engines falls off rapidly as the proportion of load decreases, it is plainly seen that a too large engine is by no means a prudent precaution.

Another matter on which a word of caution is in season is the proper size of generators to use. The size selected is too often a matter of purely arbitrary choice on the part of the purchaser, who does not take sufficiently into account such very important factors as population of town, class of inhabitants, number of churches, halls, etc. Here again, it is no economy to base one's ideas on one's own inexperience, instead of calling in professional independent advice, and so profiting by the accumulated experience of the electrical profession. The problems presented are—to get enough; to not get too much, and to arrange the generators in units of such size as that such, and as many as may be operating at any moment, may be operating at their maximum efficiency. This efficiency question is one which plays a very much more important part in the operation of electric plants than most of their owners are aware of, and if more attention were paid to it there would be less complaint about the unprofitableness of electric lighting business. The main trouble seems to arise out of the injudicious selection of sizes of generators; they being, as a rule, so selected that for the very large proportion of the time, they are operating at much less than half load. For instance, a machine of 1000 capacity may be installed in a town of 2000 inhabitants; now only for about one hour per night during the depth of winter, will that machine be called on for 1000 lights; at all other times it will be supplying less than that number, and for the greater portion of the time (from about 10 p. m. to 5 a. m.) it will be running on loads of from 900 down to 200, with the smaller number predominating. Now it is quite plain that the machine, under these conditions, will be running at full efficiency for only about 10 per cent. of time, or probably less, and that its average load will be considerably less than half. Consequently it will be running principally on half load efficiency, or even less. To the thinking mind this consideration will at once lead to the inevitable conclusion that the 1000 light generator is too large as a unit, and that one of more like 500 lights would be better to use under the circumstances. Two units of this size operating together, will supply the 1000 lights; their full load efficiency will be nearly equal to that of the 1000 light machine. When the load comes down to 500 lights then one machine will take care of it, at the same efficiency and at the lowest point of the load, viz., 200 lights. The proportion that this load bears to the 500 light full load is just double what it bears to the 1000 light full load machine. Consequently the average efficiency throughout is higher in the latter case than it was in the former, and the economy greater. It cannot be too strongly impressed on central station owners that the division of their generating plant both steam and electric into economical units is a most important matter.

BOILER FEED PUMPS.

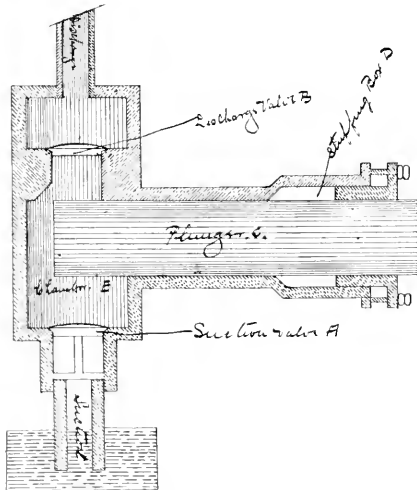
By WM. THOMPSON, Montreal, West.

A RECENT visit to a small plant, operated by a somewhat young engineer who was constantly having trouble with his boiler feed pump, owing to want of knowledge as to the principles of construction and operation, must be my excuse for again troubling my fellow engineers. At the outset allow me to say that it is not my intention to discuss the use of feed pumps from an economical standpoint, but as far as my ability will allow me to endeavor to explain the principles of operation of the ordinary feed pump to be found in use in many of our engine rooms at the present day.

In a few instances I have found pumps connected direct to the boiler and pumping direct thereto, delivering the feed water to the boiler at the same temperature as it left the water cylinder of the pump. In some cases no attempt had been made to heat the water, and in others a tank filled with water was heated by means of a jet of steam, taken usually from the exhaust main, and the temperature of the water raised as high as they could get it, or as high as they could get the pump to handle it. Most modern plants are now, however, fitted with some kind of apparatus for heating the water after it leaves the pump and before it enters the boiler. In non-condensing plants this is usually done by means of a tubular heater constructed on the principle of distributing a large amount of heating surface to the cold water, or inversely to the principles of the surface condenser. This heater is commonly situated at some point in the exhaust main, and makes at once an admirable means of heating the boiler feed water at the smallest possible cost. In condensing plants a great many means are adopted, but apparently the engineers of to-day prefer the use of "economizers," through which the water is forced, and the waste gases from the furnace are utilized for the purposes of heating, thus enabling the engineer to utilize full value of his fuel to the last possible moment.

There are so many forms of boiler feed pumps working under so many different conditions of service, that I shall not attempt to describe any of them, except to take for an example the simplest form of a pump operated from some part of the engine or its reciprocating parts, and commonly known as a single acting plunger pump.

The principles of action of this pump may be explained from the accompanying diagram, representing a single acting plunger pump shown in section, and with the suction embedded in water, the



pump being empty, valve A being the suction valve, and valve B being the discharge valve, the plunger C being operated from some part of the machinery giving the necessary motion.

The water has the pressure of the atmosphere resting upon its surface, and the pump being also filled with air at atmospheric pressure, the inner face of the valve within the suction pipe is also under atmospheric pressure, and consequently in a state of equilibrium.

Now, suppose that the stuffing box D has been securely packed to prevent the admission of air, and that plunger C has been moved to the right, as no more air can get into the pump, that already within it will expand and as a consequence will become lighter, therefore the pressure on the inner face of the suction

valve A will have been reduced, and as a result the water will rise up in the pipe, raising suction valve A in its passage and into pump chamber E. Let me here say that this act is very frequently misunderstood by young engineers and is the cause of a great deal of his troubles; he imagining that the moving of the plunger to the right drew or sucked the water into the pump chamber E, while as a matter of fact the water rises in the suction pipe owing to the pressure on the inner face of valve A having been reduced, as a result of the expansion of the air previously mentioned; therefore, the pressure of the atmosphere exerted on the surface of the water forces the water up into the pump chamber. To obtain this result the engineer will notice that it is compulsory that the admission of air to pump chamber must be prevented, or expansion cannot be effected, or in other words a vacuum will not be created, and the respective weights between the two points will not have been in any way changed, and water will as a consequence remain stationary.

The water inside the pipe will rise above that outside in proportion to the amount to which it is relieved of the pressure of the air, and that if the first stroke of the plunger to the right reduces the pressure from 15 pounds per square inch (atmospheric pressure) to 14 lbs., the water will be forced up the suction pipe a distance of about $2\frac{1}{4}$ feet, because a column of water one square inch in section and $2\frac{1}{4}$ feet high is equal to one pound in weight.

When the plunger has completed its travel to the right, the suction valve will fall to its seat and enclose the water in the pump chamber; but as soon as the plunger moves back to the left and enters the pump chamber it will compress the water and force it to raise the discharge valve (B), and expell from the pump a volume of water or air equal in volume to the cubical contents of that part of the plunger that enters the pump chamber and displaces water. To prevent the plunger from forcing the water in the pump chamber back to the suction pipe the suction valve must first close and remain closed until the plunger has completed its stroke to the left. And if when the plunger was at the end of its stroke to the right the pump was partly filled with air, this air will be expelled from the pump before any water is; but if the pump was filled with water, then water only will be delivered.

Now let us suppose that the plunger during its first stroke reduced the pressure within the pump chamber from 15 to 14 lbs. per square inch, and that the second and each subsequent stroke of the plunger reduced the pressure in the suction pipe one pound each stroke, the water in the suction pipe will rise $2\frac{1}{4}$ feet for each stroke of the plunger, until the weight of the column of water within the suction pipe is equal in weight to the pressure of the atmosphere bearing on the surface of the water; and thus to ascertain how far a pump of this kind will cause the water to rise, will be found by calculation to be equal to a column of water nearly 34 feet high. Consequently it must always be borne in mind that no matter how high the pump may be set above the level of the water, it is impossible for the water to rise more than 34 feet up the suction pipe, no matter how perfect a vacuum can be got, because the force that propels the water is a fixed quantity of about 15 lbs. to the square inch, and it cannot raise a column of water greater in weight than itself. It is considered excellent practice when a pump will create a vacuum sufficiently good to raise water 30 feet.

This principle of operation is applied to all feed pumps with, however, many different mechanical appliances, to suit different purposes and conditions of service.

When this pump, or rather this style of pump, is applied to the purpose indicated, it will be observed that the pressure within the pump chamber when the plunger is discharging is at all times equal to the pressure contained in the boiler, and that to secure the proper performance of the pump for feed purposes, the following methods of construction and operation must be observed, viz:

1st: That the vertical distance between the top of the pump chamber E and the surface of the water must not be more than 30 feet, and that all pipes and connections must be perfectly air tight to prevent the admission of air between the valve and the water.

2nd: That the suction valve must weigh less than 15 lbs. per square inch of cross section. It will be borne in mind that the weight of the valve acts directly on, and against the pressure of the atmosphere on the surface of the water, and reduces the height to which the water will rise directly as the pressure required to be exerted per square inch on the valve to raise it off its seat. An instance of this occurs to my mind, where an engineer of my acquaintance purchased at second-hand a duplex steam pump, which my friend set up to pump water from a tank to his boiler. Much to his

surprise he found it would not work, although he knew it had been doing excellent service where last in use. On examination he found that the springs on the suction valves had been adjusted at about 30 lbs. per square inch to suit former service, where water was pumped direct from town mains. As soon as proper adjustment had been made the pump performed quite satisfactorily.

3rd: That all air must be excluded from pump cylinder or chamber, and that all flanges and stuffing boxes must be kept tight, not only to prevent the admission of air, but to prevent leakage of water while pump is in operation.

4th: The discharge valve and pipe must also be clear, and all check valves, stop valves, etc., in proper working order, so that the plunger, or piston of the pump, will not be subject to any greater pressure than that within the boiler.

It will be unnecessary for me to add that water sufficiently hot to form steam at atmospheric pressure cannot be pumped owing to the destruction of the vacuum by the vapor. Nor will it be necessary to enumerate the various disorders to which pumps are subjected, as all minor troubles can invariably be traced to some of the causes already discussed.

THE MEASUREMENT OF RESISTANCE.

SINCE the resistance of no two metals is the same, it was necessary to select the resistance of some accurately defined substance as a standard of measurement. The unit adopted by the international electrical congress in 1893 and called the ohm, after the discoverer of what is called Ohm's law, is "the resistance offered to any unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass of a constant cross sectional area and of a length of 106.3 centimeters." From this is obtained the standard unit of resistance, but for practical purposes wires of known resistance or resistance coils are used.

The resistance coils require great accuracy in their measurement, in the insulation of the wire and in the mounting of the coils. The wires must be carefully selected and tested. The insulation must be such as will withstand the highest temperature to which it is subjected without change. Silk thread is extensively used for the insulation. The wire is usually wound on spools or in coils so as to occupy as little room as possible, and are mounted in a box, which protects them from injury and places them in a convenient form to be carried. The ends of the coils are connected to plates or binding posts in the cover. This, also, must be carefully constructed so that the resistance at the point of contact will be as low as possible. A single coil is sometimes placed in an ebony case, or any number, according as the work for which it is to be used seems to require. When a large number is placed in one box the ends of the wires are usually connected to metal blocks, placed at such a distance apart that a metal plug will make a good connection between any two.

The resistance coils being uniform in size, the entire resistance or any part may be used. This is one of several styles of resistance boxes which are manufactured by instrument makers, and is the one commonly used. In measuring the resistance of an electric circuit, we cannot take our standard of measurement as we would take a foot measure to obtain the length of a piece of timber, but we can use it in another way, which will be explained with the Wheatstone bridge. If that of which we wish to measure the resistance is carrying a current and we have a voltmeter and ammeter so we may obtain the difference of potential and amount of current, the resistance is easily obtained by means of Ohm's law, the resistance equaling the electromotive force divided by the current.

ELECTRICAL ITEMS WORTH REMEMBERING.

DROPPING a steel magnet, or vibrating it in other ways, diminishes its magnetism.

It is said that steel containing 12 per cent. of manganese cannot be magnetised.

Flames and currents of very hot air are good conductors of electricity. An electrified body placed near a flame soon loses its charge.

In changing a secondary battery, the charging electromotive force should not exceed the electro-motive force of the battery more than 5 per cent.

The resistance of copper rises about 0.21 per cent. for each degree Cent.

A lightning rod is the seat of a continuous current, so long as the earth at its base and the air at its apex are of different potentials.

The rate of transmission on the Atlantic cables is eighteen words of five letters each per minute. With the "duplex" this rate of transmission is nearly doubled.

The effect of age and of strong currents on German silver is to render it brittle. A similar change takes place in an alloy of gold and silver.

To obtain the number of turns of wire in an electro-magnet, multiply the thickness of the coils by the length, and divide by the diameter of the wire squared.

A test for the porosity of porous cells consists in filling the cell with clean water and taking the per cent. of leakage. The correct amount of leakage is 15 per cent. in 24 hours.

If the air had been as good a conductor of electricity as copper, says Prof. Alfred Daniell, we would probably never have known anything about electricity, for our attention would never have been directed to any electrical phenomena.

For resistance coils, for moderately heavy currents, hoop iron, bent into zigzag shape, answers very well. One yard of hoop iron $1\frac{1}{2}$ inch wide and 1-32 inch thick measures about 1-100 of an ohm.

The voltage of a secondary battery must always be equal to or slightly in excess of the voltage of the lamp to be burned. For example, a 20 volt lamp will require 10 secondary cells, but ten cells will supply more than 20 lamps.

Compression of air increases its dielectric strength. Cailliet found dry air compressed to a pressure of 40 or 50 atmospheres resisted the passage through it of a spark from a powerful induction coil, while the discharge points were only 0.05 centimeter apart.

An accumulator with 17 plates, 10 by 12 inches, is reckoned, in horse-power hours, equal to about one horse-power hour. Taking this as a basis, it will require 6 cells for one horse-power for 6 hours, or 30 cells for 5 horse-power for the same length of time.

To obtain the length of wire on an electro-magnet, add the thickness of the coils to the diameter of the core outside of the insulation, multiply by 3.14, again by the length, and again by the thickness of the coils, and divide by the diameter of the wire squared.

Blotting paper, saturated with a solution of iodide of potassium to which a little starch paste has been added, forms a chemical test paper for testing weak currents. When the paper (slightly damp) is placed between the terminals of a battery, a blue stain appears at the anode, or wire connected with the carbon or positive pole of the battery. Scientific American.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

SEVENTH ANNUAL CONVENTION.

THE limestone city of Kingston was honored this year as the seat of the seventh annual convention of the Canadian Association of Stationary Engineers, which was called for the 17th, 18th and 19th of August. The duties of entertainment therefore devolved upon Kingston Branch No. 10, and the manner in which the delegates were received proved conclusively their qualifications in this respect. While the number in attendance was not as large as desired, the convention throughout was extremely interesting and enjoyable.



MR. JAS. DEVLIN, Kingston, President.

J. Devlin, Kingston, vice-president; E. J. Philip, Toronto, secretary; R. C. Pettigrew, Hamilton, treasurer; W. F. Chapman, Brockville, conductor; F. G. Johnston, Ottawa, doorkeeper.

The Executive president, Mr. Blackgrove, occupied the chair, and on his left sat vice-president Devlin.

The delegates and visitors from the various places were as below:

Toronto—A. E. Edkins, John Fox, W. Selby, J. Huggett, R. Pink, J. G. Bain, C. Moseley, A. M. Wickens, W. G. Blackgrove, Geo. Grant, Wm. McKay.

Montreal—B. A. York, John Murphy, Wilbur Ware, O. E. Grandberg, J. J. York, Frank J. Greene.

Hamilton—R. C. Pettigrew, W. Norris.

Ottawa—F. G. Johnston, F. Robert, F. J. Merrill.

Guelph—C. J. Jorden.

Warton—F. J. Cody.

Brockville—W. F. Chapman, J. McCaw.

Carleton Place—J. McKay.

Nearly all the members of the local association were present at some time during the session, prominent among whom were Sandford Donnelly, president; John Tandvin, secretary; Charles Selby, treasurer; Daniel Reeves, John McDonald, Charles Asselstine, Thomas Burns, Fred Simmonds.

The president presented the delegates to the Mayor, who gave a brief address of welcome. He expressed himself as being assured that the subjects coming before the convention would receive that consideration which their importance demanded. Being informed that the constitution of the association very properly provides that the organization shall not be used as a means to encourage strikes or interference in any way between its members and their employers, he thought this fact a

matter for congratulation. "In coming from all parts of the Dominion to assist in educating the minds of others in your calling," he said, "Your mission is as noble as your calling is responsible. We all must recognize the importance of having responsible and reliable men placed in positions where human lives are placed at their mercy. It is, therefore, a personal pleasure for me to welcome a representative body of brother mechanics to our city; men who thoroughly understand the subjects they discuss and who can practice what they preach; men possessing a thorough and practical knowledge of their calling. I trust your deliberations while in our city will be beneficial to your order and the public in general." During their leisure hours the Mayor requested the delegates to visit the various public buildings and places of interest throughout the city.

The president replied that it was equally pleasant for him to thank His Worship for the kind and hearty welcome. The reception was thoroughly appreciated by the delegates, who had come to the beautiful city for both business and pleasure—business to discuss matters whereby both manufacturer and steam user may profit by their experience. He extended to the Mayor and Council a cordial invitation to visit the convention at any time. The delegates were confident they would be right royally entertained. The association's objects were purely educational, believing it is never too late to learn.

PRESIDENT'S ADDRESS.

In addressing the convention the president stated his gratification at seeing so many familiar faces present, and he felt in good company. He made a touching reference to the late Bro. Duncan Robertson, of Hamilton, whose death occurred shortly after the last convention in Ottawa. A faithful officer, a true friend and kind husband, his death was deeply regretted.

He asked the new members to join heartily in the work to be done. The most important question to come up would be the changing of the name of the association, and he hoped the brothers would weigh their thoughts before expressing their views on the matter. Another important question would be the holding of the convention every two years, instead of annually as in the past.



MR. E. J. PHILIP, Toronto, Vice-President.

The compulsory issuing of certificates of membership and other topics of interest would also be considered. He stated that Stratford No. 3 had been reorganized, and an application had been received from Waterloo, where it was desired to inaugurate a branch association. He called the attention of the members to the programme that was laid before them, and thought it was the best the association had ever had. From the correspondence received from Brothers Tandvin and Devlin he felt perfectly satisfied that the members of Kingston No. 10

were a whole-souled and hard-working lot of men. Nothing had been left undone in the way of making this meeting both successful and entertaining to the delegates.

The secretary then read the minutes of the last convention, which were adopted.

Standing committees were appointed as follows :

Auditing Committee—Bros. F. G. Johnston, W. Selby, J. G. Bain.

Constitution and By-Laws—Bros. J. J. York, chairman; A. M. Wickens, W. Norris, C. J. Jorden, S. Donnelly.

Educational and Good of Order—Bros. A. M. Wickens, chairman; J. J. York, J. Devlin.

Mileage—R. C. Pettigrew, chairman; C. Moseley, J. Murphy, J. F. Cody, F. J. Merrill.

Credentials—Bros. O. E. Granberg, chairman; J. Huggett, W. F. Chapman.



Mr. W. F. CHAPMAN, Brockville, Secretary.

Bro. Devlin asked what had been done in connection with securing reduced rates from the Correspondence School of Scranton, Pa., to which the Secretary replied that he did

not understand their terms, as a scholarship would cost a member of the association the same as an outsider. Mr. H. S. Robertson, who represented the school, gave a statement of the facts, which showed that the Canadian association could obtain the same privileges as the International association. By these privileges members were not compelled to take their educational course in full, but could take up any branch desired.

The secretary was asked what had been done towards securing a reduced insurance rate for members of the association. He stated that several insurance companies had promised to give the association reduced rates by deducting the agents' commission. In his opinion the death rate had been increased by the encroachment of scientific inventions.

The convention then adjourned, to meet again in business session in the evening.

At 2 o'clock in the afternoon about four hundred delegates and their friends boarded the steamer Hero for a sail on the St. Lawrence among the Thousand Islands. Although attended with occasional showers of rain, the trip was thoroughly enjoyed, and to many was quite a revelation. On the return trip the city was reached about nine o'clock.

EVENING SESSION.

Reassembling in convention, Bro. John Fox, chief engineer at O'Keefe's brewery, Toronto, read the following interesting paper :

ICE MAKING MACHINERY.

For some time I have looked forward to the preparation of a short paper on cold storage and refrigeration, and in presenting it I will endeavor to be as practical in my few remarks as the subject will admit. I will therefore dwell principally on that system of refrigeration which is

now under my charge at the O'Keefe Brewing Co.'s works, namely, the "Delevergine," or direct expansion system. The substance used in this system is anhydrous ammonia. We are told that ammonia is a combination of nitrogen and hydrogen, expressed by the formula NH_3 , which means that an atom of nitrogen (representing 14 parts by weight) is combined with three atoms of hydrogen (representing 3 parts by weight), at ordinary temperatures. The ammonia, or anhydrous ammonia, as it is called in its natural condition, is a gas or vapor, at the temperature of 30° F. It becomes a liquid at the ordinary pressure of the atmosphere, and at higher temperatures also, if higher pressures are employed. The anhydrous ammonia dissolves in water in different proportions, forming what is known as ammonia water, liquid ammonia, aqua ammonia, etc. At a temperature of 900° F. ammonia dissociates, that is, it is decomposed into its constituents, nitrogen and hydrogen. The latter being a combustible gas, it appears that partial decomposition takes place at lower temperatures, but probably not to the extent frequently supposed.

Ammonia is not combustible at the ordinary temperatures, and a flame is extinguished if plunged into the gas, but if ammonia be mixed with oxygen, the mixed gases may be ignited and will burn with a pale yellow flame. Such mixtures may be termed explosive in a sense. If a flame sufficiently hot is applied to a jet of ammonia, it (or rather the hydrogen of the same) burns as long as the flame is applied, furnishing the heat for the decomposition of the ammonia.

Ammonia is not explosive, but when stored in drums with insufficient space left for it to expand, with a high temperature, the drums will burst, as has happened in hot seasons.

Ammonia vapor is highly suffocating and for that reason persons employed in rooms charged with ammonia gas must protect their respiration properly.

With the direct expansion system, the liquid ammonia is directly conducted to the place where heat shall be absorbed, or, we might say, into the rooms which are to be cooled. The gas is then drawn back to the machines or compressors, where it is again compressed and discharged into a pressure tank, and from there to the condenser, where it is again liquefied. In liquefying the gas, cold water is allowed to trickle over the condenser, or we might call it the condensing coils, thereby cooling the ammonia. The liquid then passes on to the separating tank and if any oil should get into the liquid it is caught there. The ammonia then goes on through expansion valves into cold storage rooms where the heat of room is absorbed, thereby cooling or lowering the temperature of same, completing its work thus to repeat its circulation over and over again.

Now let us see what we have to consider in the shape of mechanical work performed. As you may know the equivalent of a ton of ice is 284,000 heat units, or the amount of heat that is required to convert a ton of ice at 32° F. into a ton of water at 32° F.; or conversely, it is the amount of heat that must be extracted from a ton of water at 32° F. in order to convert it into a ton of ice at 32° F.

Let us take, for instance, a 50 ton plant. The latent heat of one pound of ice is 142 heat units; multiplying this by 2,000 gives us the number of heat units in one ton. Now, as we are considering a 50 ton plant, this will be 14,200,000 heat units in 24 hours of time, or in other words, a 50 ton plant in 24 hours will absorb this amount of heat units. I might say here that in speaking of a plant of so many tons capacity, it is always understood to mean for 24 hours of time.

The temperature of expanding ammonia would have to be about 10° F. lower than the temperature of a cold storage room, which we will take as 35° F., consequently by using latent heat of vaporization at that temperature, which is 35° F. - 10° F. = 25° F., we find it to be 540.03, which is refrigerating effect of 1 lb. of ammonia when the temperature of refrigeration is 25 deg. F., and that of condenser 70 deg., specific heat of the ammonia being 1 deg. F. The amount of ammonia to be evaporated, therefore, per minute of our 50 ton plant is $(540.03 \div 25) = 495.03$ latent heat of ammonia at 25 deg. F. Omitting the decimals and taking this in round numbers, $495 \times 60 = 29,700$. This divided into $50168.33 = 19.02$, which is the number of pounds of ammonia we require per minute for our 50 ton plant. We require about 20 lbs., and the volume of 1 lb. of ammonia vapor at 25 deg. F. is equal to 5.26



Mr. R. C. PETTIGREW, Hamilton, Treas.

cubic feet, consequently compressor capacity per minute will have to be 105.20 cubic feet. If we add to this 20, which is a fair allowance for losses by radiation, etc., we require an actual compressor capacity of 126.24 cubic feet per minute.

Let us see how the plant I operate compares with this theoretical calculation just made. The compressor cylinders are 11" x 22", which is equal to about 1 1/5 cubic feet capacity of each cylinder. Our engine makes 40 revolutions per minute and each is double acting. Diameter 11" x 11" = 121 x .7854 = 95.0334 x 22 ÷ 1728 = 1.2099. Consequently at each revolution of crank shaft each compressor discharges its contents twice, which gives us a total discharge of about 192 cubic feet per minute. If we deduct 20% from this for clearance, losses, etc., we get 154 cubic feet, or about 27 feet more than required by our theoretical calculation, which would be the amount allowed to come and go on, which I think close enough for all practical purposes.

Now comes the question of piping required for cold storage rooms. In piping cold storage rooms, from what information I can gather on this subject, it is usual to allow about one square foot of pipe surface for every 3,000 heat units to be absorbed. This is equal to about 1.6 running feet of 2 inch pipe. For a 50 ton plant, according to this rule, we will require a sufficient amount to absorb 14,200,000 heat units in 24 hours, which in round numbers will be 14,200,000 ÷ 1.6 ÷ 3,000 = 7,573 running feet of 2 in. pipe. Of course you understand this estimate is approximate. If we were using 1 in. pipe instead of 2 in. pipe, and the same factor, namely, 3,000 heat units, to be absorbed in 24 hours per each square foot of pipe surface exposed, it would require about 2,833 running feet of pipe. The condensers are a system of pipes or coils into which the ammonia, after being compressed in compressors, is forced, where it is cooled by cold water trickling over the pipes. These are called atmospheric or surface condensers. The ammonia in passing through the condensers yields to the cooling water the heat which it has acquired in doing refrigerating duty by its evaporation and the heat it has acquired during compression, superheating being prevented by a liberal supply of oil in our case.

The mechanical work done during compression is converted into its equivalent of heat. This amount of heat is also equal to the latent heat of volatilization of the ammonia at the temperature of the condenser. The efficiency of the condenser determines in a great measure the economical working of the machine, and for this reason it is good policy to have as much condenser surface as practical consideration may permit. It is said for average conditions (incoming water 65 deg. F., outgoing 85 deg. F.) it will require 20 square feet of surface per ton, or for a 50 ton machine it will take 1,600 linear feet of 2 inch pipe. The main difference of outgoing and incoming water is 20 deg., 485.42 x 20 ÷ 60 ÷ 20 ÷ 8.33 = 3496, which is amount of water in gallons per hour.

GREEDERWORKS FOR ECONOMIZING COOLING WATER.—Where cooling water is very scarce, and especially where atmospheric conditions—dryness of air, etc.—are favorable, the cooling water may be re-used by subjecting the spent water to an artificial cooling process by running the same over large surfaces exposed to the air in a fine spray. A device of this kind is described as being a chimney-like structure, built of boards. Its height is 25 feet, the other dimensions being 8' x 8'. Inside this structure are placed a number of partitions of thin boards, spaced 4 inches apart, extending to within 1 foot of the bottom of the structure; but the lower halves of these partitions are placed at right angles to the upper halves. This arrangement gives better results than unbroken partitions. The water to be cooled enters the structure at the top, where, by the use of a galvanized iron overflow gutter, it is spread evenly over the partitions and walls and flows downward in thin sheets. At the base of the structure air is introduced in such quantity that the upward current has a velocity of about 20 feet per second. The air meeting the downward flow of water absorbs the heat by contact and also by vaporizing during the passage, 20 deg. F.

The oil used for lubricating the compressors differs from ordinary lubricating oil in that it must not congeal at low temperatures, and must be free from vegetable or animal oil. For this reason only mineral oils can be used, and of these only such oils as will stand a low temperature without freezing, such as the best paraffin oil will do.

Bro. Edkins wished to know what a 50 ton ice plant was.

Bro. Fox replied that it absorbed the heat in a cold storage room with the same power as would 50 tons of ice kept at 32° F.

Bro. J. J. York said that only the previous week the Board of Trade of Montreal had met to consider the introduction of ice-making machinery on the steamships. It was a subject which the intelligent engineer would have to grapple with sooner or later.

A hearty vote of thanks was tendered to Bro. Fox for his paper.

Mr. J. M. Campbell, of Kingston, promised a paper on "Electrical Appliances," but was unavoidably absent from the city.

A visit was then paid to the electric light and gas works, under the direction of Mr. Simmons, the superintendent, who showed the delegates some experiments with acetylene gas.

SECOND DAY.

The convention resumed at 10 a.m., the president in the chair.

Bro. E. J. Philip, Executive Secretary, presented his report, which showed that the total receipts for the year were \$607.22 and the expenditure \$505.65, leaving a balance of \$101.57. The strength of the association had not been up to that of former years, neither numerically nor financially, but a large amount of good had been done by the association taking up the matters of education, insurance and certificates, and while none of these had been as successful as was anticipated, the probability was that during the following year they would be got into better shape. He suggested that the cost of certificates be lessened to the members and that they be made compulsory. He again reported at length on insurance and the Correspondence School, as also on a scheme that would make the Executive more of an educator, by establishing a Bureau of Information.

The Committee on Constitution and By-laws presented a report, which recommended that it be made compulsory to secure membership certificates, and that a reduction be made in the number of officers. This was necessary in order to meet expenses. The movement met with much opposition, some proposing raising the per capita tax, while others suggested meeting in convention every two years. The committee was requested to report again the following day.

The report of the Treasurer was then presented, in which it was stated that the Association had felt the effects of the commercial depression. There was a balance on hand of \$101.57.

The report, which was certified correct by the auditors, was adopted, and the meeting adjourned for lunch.

At 2 o'clock, by the courtesy of Mr. B. W. Folger, manager of the street railway, a special car took the delegates and friends to the penitentiary. Mr. Devlin, chief engineer, escorted the visitors through the institution. They were shown a small hand engine built by the famous Percy, of Montreal, forty years ago, for the penitentiary, which cost \$1,100. Over the door of the engine room was the lettering "Welcome C.A.S.E." surrounding the British coat of arms. On the wall was a crown of colored incandescent lights. Rockwood asylum was also visited, and in the evening the members had an outing at Lake Ontario Park.

THIRD DAY.

At 9 a.m. on Thursday the business of the convention was again taken up.

The report of the Committee on Constitution and By-laws was adopted. It recommended the granting of a free certificate to every member of the association in good standing and the raising of the per capita tax 25c.

The report of the Committee on Education and Good of the Order recommended that members should take a

course in the International Correspondence School. This report was also adopted.

Bro. Edkins suggested the advisability of taking steps to secure Dominion legislation compelling all engineers to hold certificates, instead of as at present, through the provincial government.

Bro. Granberg said Quebec would give every assistance. If there was a compulsory law passed by the Dominion government, the certificate holders of the Ontario association would readily join the Canadian association, and allow the former to lapse. This would bring in a membership of from 700 to 800.

Bro. Wickens said he had been through five legislative fights, and advised them to ask for enough, so that they would be able to get something.

It was moved by Bro. Edkins, and seconded by Bro. Philip, that a committee be appointed to co-operate with the executive board of the Ontario association with a view to securing Dominion legislation for the compulsory examination of stationary engineers. Carried.

It was resolved to publish a hand-book, giving a list of all the engineers in Canada, which number about 12,000.

The mileage report was then adopted.

Bro. Norris moved that a quarterly report from the Executive Secretary be sent to each branch giving its standing. Carried.

ELECTION OF OFFICERS.

The next order of business was the election of officers. The president appointed Bro. Edkins returning officer and Bros. Robert and Tandvin scrutineers.

For president Bro. James Devlin, of Kingston, was elected by acclamation.

For vice-president four nominations were made, Bros. Philip, Pettigrew, Granberg and Chapman. Bro. E. J. Philip, of Toronto, was elected.

The contest for secretary was between Bros. W. F. Chapman, Brockville, and R. C. Pettigrew, Hamilton, the former being successful.

Bros. Pettigrew, B. A. York and Granberg were in the field for treasurer. Bro. Pettigrew was elected.

For conductor there were eight nominees, Bros. Huggett, Murphy, Bain, Wickens, B. A. York, Moseley, Johnson and Jorden. Bro. J. Murphy, of Montreal, was successful.

Bro. F. J. Merrill, of Ottawa, was elected door-keeper. The other candidates were Bros. Huggett, Fox, Jorden, McKay, Johnston and Norris.

Past-president York installed the newly-elected officers, and the retiring president, Bro. Blackgrove, was presented with the customary jewel.

The officers elected thanked the convention for the honor conferred upon them and promised to endeavor to further the best interests of the C. A. S. E.

A vote of thanks was tendered the returning officers and scrutineers.

Votes of thanks were also tendered the Kingston Street Railway Company, the International Correspondence School, the Mayor and city council, the local association and the press.

Brockville and Hamilton both tendered for next year's convention, with the result that Brockville was chosen.

The president-elect appointed Bro. Granberg district-deputy for Quebec and Bro. Cody district-deputy for Ontario.

Bros. Wickens, Edkins and Norris were appointed a Committee on Legislation.

After conclusive remarks the convention closed by singing "God Save the Queen."

At 3 p. m. the members took carriages for a drive to Kingston Mills and Fort Henry, lunching at the former place.

THE BANQUET.

A banquet at the British American Hotel on Thursday evening fittingly closed the convention. The chair was occupied by President S. Donnelly, of Kingston No. 10. On his right sat the Mayor, Aldermen Skinner, Ryan and Tait. On his left was Executive President Devlin, Past President Blackgrove and Past President Wickens.

The first toast on the list was "The Queen," which was honored by singing the National Anthem.

The Mayor and Ald. Skinner, Ryan and Tait responded to the toast of the "City of Kingston."

"The C.A.S.E., its Aims and Objects," brought replies from Bros. Wickens, J. J. York, Granberg and Norris. Bro. Wickens said that the C.A.S.E. was

bound to succeed, for it was founded on the rock of knowledge. Intelligent engineers did not believe in accidents; explosions were due to carelessness or ignorance.

Bro. York said that if all the engineers were as proud as he was to be a member of the C.A.S.E. the membership would increase ten fold. Steam users contemplating remodelling their plants or installing new machines should consult the C.A.S.E.



MR. S. DONNELLY, President, Kingston No. 10.

Bros. Granberg and Norris spoke briefly of the advantages afforded by the association.

"Our Manufacturers" was acknowledged by Mr. Anderson, of the Imperial Oil Company. He spoke of the practical emigration policy required in Canada, and advocated the further extension of foreign trade.

Mr. Robertson, of the Correspondence School at Scranton, responded to the toast "Our Technical Educators."

"Our Visitors and Kindred Societies" brought replies from Bros. Blackgrove and Edkins. Bro. Edkins said that many thought that the O.A.S.E. was an antagonist to the C.A.S.E., which was not the case. As soon as Dominion legislation compelled qualified licensed engineers the O.A.S.E., with its 700 members, would amalgamate with the C.A.S.E. He showed how dangerous it was to place boilers in the care of incompetent men, by giving the relative explosive forces of steam and dynamite.

"Kingston No. 10" was acknowledged by Bros. S. Donnelly and J. Devlin.

"The Executive Council" was replied to by Bros. Devlin, Philip, Pettigrew and Chapman; "The Ladies" by Bro. Granberg and Ald. Tait, and "The Press" by

representatives of the Kingston Whig and News, and the Canadian Engineer and ELECTRICAL NEWS, of Toronto.

The entertainment was interspersed with songs by Messrs. Grant, Blackgrove, Cochrane, Skinner, Murphy and Rubert.

MR. JAMES DEVLIN.

Mr. Devlin, president-elect of the C. A. S. E., was born in Kingston, and is the eldest son of the late P. Devlin, a veteran fireman. After serving his apprenticeship with the Canadian Locomotive and Engine Company, he worked for a time with D. Ewen & Sons, and in 1873 was appointed engineer of the Government waterworks. Two years after he was transferred to the penitentiary at St. Vincent de Paul, near Montreal, as chief engineer. In 1885 he received the appointment of chief engineer of Kingston penitentiary, which position he still occupies. His connection with the C. A. S. E. dates from the year 1892, and since that time he has been an active worker. He was largely instrumental in securing the formation of the Kingston branch, and at the annual convention at Ottawa last year he was unanimously elected to the Executive Committee as vice-president, and filled the position with such credit that his qualifications for the duties of president are unquestioned. He is also a member of the Board of Examiners of the Ontario Association of Stationary Engineers, and a strong advocate of compulsory examination of engineers.

SPARKS.

An electric light plant will probably be installed in the asylum at Brockville, Ont.

The Sherbrooke Telephone Co., of Sherbrooke, Que., is building 100 miles of new lines.

A by-law has been carried by the ratepayers of Listowel, Ont., in favor of electric lighting.

The Prescott Electric Light Co., of Prescott, Ont., contemplate making additions to their plant.

Local parties will probably install an electric light plant for street lighting at Winchester, Ont.

The Ottawa Electric Light Co. intend putting in a 7,000 candle power machine in No. 2 power house.

It is said to be the intention of Mr. Comstock, of Brockville, to place an electric light plant in his yacht.

On the 17th of August the ratepayers of Huntsville, Ont., sanctioned a by-law providing for an electric light plant.

It is announced that a gentleman from Halifax proposes establishing an electric light plant at Shubenacadie, N. S.

The plant of the Owen Sound Electric Light Co. is being enlarged to supply incandescent as well as arc lights.

The Galt, Preston & Hespeler electric railway carried 35,000 passengers and 930 tons of freight during the month of July.

The Auer Light Co., with a capital of \$30,000 has been organized in Ottawa. Mr. C. S. Taggart has been appointed manager.

The Listowel Gas Co., of Listowel, Ont., purpose installing an electric plant when the present contract for lighting the town expires.

The Trojan Car Coupler Co.'s branch at Smith's Falls, Ont., are supplying the Quebec and St. John electric road with car couplers.

Incorporation is being sought by the Amherstburg Electric Light, Heat & Power Co., of Amherstburg, Ont., with a capital stock of \$20,000.

It is reported that Michael & Becker, owners of a patent telephone system, are prepared to make an offer for the telephone franchise of Toronto.

The city council of Windsor, Ont., have purchased the machinery in the electric lighting station from E. Leonard & Sons, of London, at the price of \$2,685.

Mrs. R. McLaughlin, of Summerville, has entered a suit

against the Toronto & Mimico Electric Railway Co., to recover \$20,000 damages for the death of her husband, who was killed by one of the company's cars.

Owing to the destruction of the power house of the Montreal Park & Island Railway Co., two new power houses are being erected, one at Lachine and the other at St. Laurent.

The Electric Railway Co. at Sherbrooke, Que., is said to be negotiating for water power at Brompton Falls, and if successful will commence the construction of the road at an early date.

Dr. Harrison Chamberlain has presented to the city council of Buffalo a petition asking for permission to construct and maintain a telephone system in that city. It is proposed to organize a new company.

The Hamilton, Chedoke & Ancaster Electric Railway Co. have secured almost all the right of way necessary for their proposed line, and steps are now being taken to organize the company. It is the intention to have the road in operation early next summer.

In the decision of the Privy Council in the case of the Toronto Street Railway Co. re the duty on steel rails, several other railway companies are interested, as follows: London Street Railway Co., \$12,000 to \$15,000; Hamilton Street Railway Co., \$18,000; Windsor Street Railway Co., \$6,000. The Winnipeg Street Railway Co. is also said to be interested.

Incorporation has been granted to the Callendar Telephone Exchange Co., with head office in Toronto. The object of the company is to deal in telephone patents, and to build and operate telephone lines throughout Canada. The promoters are: Romaine Callender and Edward H. Hart, of Brantford, and J. Enoch Thompson, of Toronto. The capital stock is \$100,000.

The corporation of the town of Markham, Ont., have leased their lighting plant to the Markham Electric Light Company, who have extended and improved the system. They have installed a 20 K.W. alternating plant furnished them by the Royal Electric Company, and about 350 lamps. The street lighting has also been changed from arc to incandescent lights, which are giving every satisfaction.

At the annual meeting of the Ottawa Car Co., held recently, it was stated that a dividend of 8 per cent. had been paid to the shareholders and a sum equal to 4 per cent. placed to the reserve account of the company. Directors were elected as follows: Thomas Ahearn, president and managing director; James D. Fraser, secretary-treasurer; W. W. Wiley, J. W. McRae, W. Y. Soper and Wm. Scott.

The addition to the power house of the Montreal Street Railway Co. is nearing completion. A new boiler house with chimney 250 feet in height is being constructed, in which will be placed three Babcock & Wilcox water tube steam boilers and a direct-connected engine of nearly three thousand horse power. This addition has been rendered necessary in order to cope with the increasing passenger traffic.

R. Anderson, Ottawa, is applying for a patent on an electric switch to turn on one, two or three lights, or any number, in rotation. It is useful in high chandeliers on occasions where only one or two lights are required. He is also applying for a patent for an invalid's push hanging switch. One push lights the lamp and the next puts it out. This is a very simple and useful contrivance. It will be made of porcelain.

The Richmond County Electric Co. have decided to entirely remodel their plant outside the station. All their old type transformers will be discarded and be replaced by Stanley type in large units, and all their primary circuits will be transformed to 2,000 volts. By these changes they will secure twenty per cent. increase in capacity and be able to take care of their increased business without changing their present dynamos. The order for transformers and supplies has been placed with the Royal Electric Company.

At the recent carnival at Halifax, N. S., an attraction of much interest was the electrical illuminations of the war-ships and the illuminated procession of steamers, yachts and boats. The flag-ship "Crescent" was decorated with incandescent lamps, while the English and French war-ships and the cable ships "Mackay Bennett" were beautifully displayed with search lights and blue fire. On the steamer "Annie" was placed a special engine and dynamo, with strings of incandescent lamps covered with fancy shades and Wheeler reflectors. This installation was the work of John Starr, Son & Co., of Halifax, and reflected credit upon the firm.

TO AVOID FIRES FROM ELECTRICAL APPLIANCES.

The National Board of Fire Underwriters of the United States has promulgated a series of rules referring to electrical appliances for light and power. It publishes the following cautions for the information of the public.

1. Have your wiring done by responsible parties, and make contract subject to the underwriter's rules. Cheap work and dangerous work usually go hand in hand.
2. Switch bases and cut-off blocks should be non-combustible (porcelain or glass).
3. Incandescent lamps get hot; therefore all inflammable material should be kept away from them. Many fires have been caused by inflammable goods being placed in contact with incandescent lamp globes and sockets.
4. The use of flexible cord should be restricted to straight pendant drops, and should not be used in show windows.
5. Wires should be supported on glass or porcelain, and never on wooden cleats; or else they should run in approved conduits.
6. Wires should not approach each other nearer than eight inches in arc, and two and one-half inches in incandescent lighting.
7. Wires should not come into contact with metal pipes.
8. Metal staples to fasten wires should not be used.
9. Wires should not come into contact with other substances than their designed insulating supports.
10. All joints and splices should be thoroughly soldered and carefully wrapped with tape.
11. Wires should be always protected with tubes of glass or porcelain where passing through wall, partitions, timbers, etc. Soft rubber tubes are especially dangerous.
12. All combination fixtures, such as gas fixtures with electric lamps and wires attached, should have approved insulating joints. The use of soft rubber or any material in such joints that will shrink or crack by variation of temperature is dangerous.
13. Electric gas lighting and electric lights on the same fixture always increase the hazard of fire, and should be avoided.
14. An electric arc light gives off sparks and embers. All arc lamps in vicinity of inflammable material should have wire nets surrounding the globe, and such spark-arresters reaching from globe to body of lamp as will prevent the escape of sparks, melted copper, and particles of carbon.
15. Arc light wires should never be concealed.
16. Current from street railway wires should never be used for lighting or power in any building, as it is extremely dangerous.
17. When possible, the current should be shut off by a switch where the wires enter the building, when the light and power are not in use.
18. Remember that "resistance boxes," "regulators," "rheostats," "reducers," and all such things, are sources of heat and should be treated like stoves. Any resistance introduced in an electric circuit, transforms electric energy into heat. Electric heaters are constructed on this principle. Do not use wooden cases made for these stoves nor mount them on wood work.

AUTOMATIC COAL WEIGHING MACHINES FOR POWER STATIONS.

THE late Hon. Eckley B. Cox, who strongly advocated the substitution of a continuous record of actual boiler performance for the prevailing system of occasional tests, once stated the matter very tersely, saying:

"I am not so much interested in knowing what some expert may be able to do with my boilers as to know what work my firemen are actually getting from them every day."

To know this, however, means the measuring of the intake and the output means accounting for the entire supply and production, so that the necessary comparisons may be made for formulating the result. The automatic weighing machine supplies this requirement, automatically handling coal and water, much after the manner of an ordinary water meter, say, interposed in a water pipe, or a gas meter for that matter, giving a continuous and reliable record of what has passed through it.

In another way, too, may the automatic weighing machine serve a good purpose. Daniel Webster has been quoted for the way in which, in one of his speeches, he emphasized "the tremendous power of six per cent." Certainly the investor of to-day looks sharply enough to the difference of one per cent. in the rate of interest chargeable against him. But does he look as closely to the other components of the "cost?" For instance, recent experiments indicate that the anthracite coal generally used for steam making will hold about four per cent. of water without much dripping; and much of that coal is "watered" to this extent before delivery. If, now, the coal pile be replenished twice a year with wet coal, it is evident that the the buyer pays the interest rate plus eight per cent. of the purchase price as the cost of the capital employed in "carrying" the fuel account.

Although the coal cannot, for obvious reasons, always be obtained dry, the drying may be readily effected in nearly all power stations before the coal reaches the bins by using heated air drawn from the upper part of the boiler rooms. Then, by weighing in through an automatic weigher and reweighing in the same way, first to the bins, next directly to the furnaces, all of the required facts are obtained. The first weighings, by showing the amounts taken and delivered to the bins indicate the evaporation, and a comparison of the records of the second and third readings will show, at any time, the amount held in storage in each bin, besides giving the amount chargeable to each set of boilers. —Francis H. Richards in *Cassier's Magazine* for August.

ERRATA.

Mr. John Patterson, of the Power Company, Hamilton, writes: "Will you kindly correct a couple of errors in your article on the Cataract Power Co., of Hamilton, in the August issue of your paper. The water flowing over the fall is more than 6 inches by 48 feet, instead of 5 inches by 18 feet, and the head is about 210 feet instead of 270. The flow of water is over eight thousand cubic feet per minute, which at this head gives something over the 2500 horse power."

Mr. P. G. Gossler, engineer for the Royal Electric Co., Montreal, is at present engaged on the reconstruction of the Montreal station. They are replacing 17 alternators by five 300 kilowatt generators, directly connected to three engines. They are also building an entirely new switch board for light and power from the two phase circuits. Their present system of 1000 volts is being changed to a 2000 volt system and their transformers are being replaced by more modern ones. Power will be obtained from Chambly Falls, fifteen miles distant.

CORRESPONDENCE

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR: I clipped the following letter from the August issue of *Power*, and with your permission will reproduce it here, as the writer evidently has discovered some new element of danger in our already dangerous but interesting occupation:

WHERE QUICK ACTION WAS NECESSARY.

Several years ago a gentleman who is now chief in a large water works in New York had charge of an engine in a saw mill in the then wild woods of Michigan. One morning he came to the mill, and found no steam. The watchman told him that he had been firing very heavy for several hours with dry fuel. An examination showed that the boiler, dome, and steam pipes were full of water, also that the boiler and arch were excessively hot. Here was a case of danger that required a superior knowledge of engineering, philosophy, good judgment, and prompt action. What would you do?

J. W. POWER.

Will my fellow Canadian professional brethren enlighten me as to what this writer intends to explain, whether the boiler in question had become so overheated as to have become dangerous from this cause, or simply whether the engineer was fearful of detaining the sawmill hand until such time as he could reduce his water level and make the steam, the watchman had been so long trying to get?

After reading the letter I am of the opinion that the writer intends to state that the boiler was overheated and in danger of collapse from this cause. He tells us that the boiler, dome and steam pipes were full of water, but does not say how they happened to be full: quite evidently the water had fed into the boiler from some source after the engineer had shut down the previous night—a not altogether unknown occurrence, as most engineers can verify, especially when there happens to be a cold water pressure on the feed main. No matter how the thing happened, however, we are told that the apparatus in question was full, that the watchman had been firing for several hours, (apparently on this particular morning the watchman got at the fires earlier than usual); that he had no steam, that the boiler as a consequence of the untiring energy of the watchman was excessively hot, that immediate danger was so great that this model up-to-date engineer had to know so much and act so quickly under those trying circumstances that Mr. Power thinks it worthy of record as a brilliant engineering feat and wants to know what other engineers would have done under the circumstances.

Well, Mr. Power, for my part under such circumstances as these I should have kept exceedingly quiet and taken off my coat and made steam. In the first place, if, as Mr. Power tells us, the boiler, etc., was full of water, how was it that the almost incessant firing of the watchman did not impart some heat to this same water, particularly when the boiler shell was so overheated? Mr. Power no doubt knows that the circulation within the boiler was just the same under circumstances stated as it would be with some full of steam, under equal pressure, and also as heat was imparted to the water it would in course of events follow the natural law and expand. But we are told everything was full and therefore water could not expand or increase in bulk, and increase of pressure on the boiler would follow as a natural consequence and would be recorded on the steam gauge just the same as though the boiler was making steam in the usual course of events. We are told, however, that when the engineer arrived there was no steam, or in other words no pressure was indicated on the gauge. If so, then it is quite evident that the heat from the fires had never reached the water within the boiler, and that overheating of boiler plates was caused rather from want of water than there being too much water in the boiler.

After reading Mr. Power's letter I am very much inclined to believe that a very large amount of danger was imaginary and that a great many of the circumstances are the result of an imaginative brain rather than an actual occurrence.

"ENGINEER."

The Lozier Manufacturing Co., of Toronto, have applied for incorporation to build motor vehicles, etc. The capital stock is \$500,000.

Mr. Higman, head of the Government Electric Light Inspection Department, recently made a test of the electric light service supplied to the city of Toronto by the Toronto Electric Light Co. In his report to the City Board of Control he states that "voltage readings were made at 12 different lamps, which show an average pressure of 51 volts. If an average of the whole ampere readings is made we have 10.6 amperes as the current strength; this multiplied by the mean voltage gives an average of 541 watts, or 25 per cent. in excess of what the contract called for." The report concludes with the statement that "not only is the company fulfilling its obligations, but is doing so generously, and the operation of the whole plant is decidedly creditable."

BEARDSHAW'S "PROFILE" TOOL STEEL.

ON another page of this journal will be found an advertisement by Messrs. Winn & Holland, of Montreal, who have secured the sole agency for Canada for the sale of Beardshaw's Profile Tool Steel, which is now being largely introduced in Montreal. In introducing to the engineers and allied trades tool steel in a new form, little need be said, other than to point out its various applications, (which is done in the catalogues supplied by the agents) for to say, that the steel comes to the user in such form or profiles as to enable tools to be made by grinding only, is to indicate that a long-felt want has been met.

This steel is now rolled in six different sections or profiles, most required by engineers and machinists, and other profiles will be made as required. Tools for the lathe, planer, shaping, slotting and drilling machines, also chisels, rimers, taps, bits, broaches, gravers, etc., are made from this steel without forging, and there is, therefore, no wasting in the fire. The steel as it comes from the rolls is ready to cut to lengths and grind into tools, which is a great saving in time. There is also a saving over 50% in the weight of steel used.

The manufacturers claim that the quality of this steel is much finer than any ordinary tool steel put upon the market. Owing to it not being necessary to forge it, it is possible to supply a very much more durable steel, which if forged, would be liable to be spoiled by the blacksmith.

The adoption of this Profile Steel amongst the most up-to-date engineers is now an assured fact. An undoubted success of this steel has been made in Europe, and it is now being introduced in the colonies. The Profile Steel is also being produced in self-hard quality, so that no heating is necessary.

PERSONAL.

Mr. A. A. Dion, superintendent of the Ottawa Electric Light & Power Co., returned a fortnight ago from a trip to New York.

Mr. George C. Peters, manager of the New Brunswick Telegraph Co., at Moncton, N. B., recently had the misfortune to break one of his arms.

Mr. J. C. Mullen, formerly with the Ottawa Electric Railway Co., is at present engaged on the construction of a government electric line in Durban, South Africa.

It is stated that Mr. James Devlin, chief engineer of the penitentiary at Kingston, is an applicant for the position of Superintendent of Public Works for the Dominion.

Mr. A. Porter, superintendent of the Cornwall Electric Street Railway, has resigned, to accept a position in Montreal. The employees of the company presented him with a gold watch on the eve of his departure.

Mr. Angus Grant, for many years superintendent of the Great Northwestern Telegraph Co., at Montreal, died at his home in Prescott on the 15th ult. Some time ago, owing to ill health, he was obliged to resign his position.

The death occurred in Toronto early in August of Mr. Thomas Northey, father of Mr. J. P. Northey, of the Northey Mfg. Co. Deceased was well known throughout Canada, and was in his 80th year. Fifty years ago he established a foundry in Hamilton, removing to Toronto in 1880.

Mr. W. E. Davis, formerly of the Toronto Street Railway Co., and latterly electrical engineer and purchasing agent of the Detroit Railway, has resigned his position and removed to Saginaw, where he becomes manager of the Bearinger Electric Railway between that city and Bay City.

Mr. J. J. Ashworth, for several years attached to the engineering department and latterly to the agency staff of the Canadian General Electric Co., has severed his connection with the company and will engage in the future in independent engineering and construction work. The termination of Mr. Ashworth's connection with the company was made the occasion of a pleasant expression of good will on part of the Toronto staff in the form of an address accompanying the presentation of a locket with monogram suitably engraved.

It is with deepest regret that we announce the death of Mr. A. W. Congdon, of the engineering staff of the Canadian General Electric Co., to whose illness reference was made in these columns recently. The hope then expressed that he would probably recover was unfortunately not well founded, the disease having taken deeper hold upon his system than had been supposed. It is believed that in the trip which Mr. Congdon made several years ago to Japan, his constitution was undermined.

TRADE NOTES.

The Canadian General Electric Co. are installing a 500-light incandescent plant in the Winnipeg general hospital.

The Dodge Wood Split Pulley Company have removed their Toronto office from 86 King street to 74 York street.

W. A. Johnson, of Dresden, has ordered a 500 light single phase alternating plant from the Canadian General Electric Co.

The Vancouver Consolidated Ry. Co. have ordered a 150 k. w. "Monocyclic" generator from the Canadian General Electric Co.

The Niagara Falls Light & Power Co. recently started up the second of the 2,000-light single phase generators purchased from the Canadian General Electric Co.

The Hull Electric Co. have ordered a parlor car from the Canadian General Electric Co. to meet the demand for such a service on part of excursion parties from the capital city.

The Robb Engineering Co., of Amherst, N. S., are placing a 100 horse power engine and a 125 horse power Monarch boiler in the power house of the Moncton Street Railway Co.

Messrs. Hooper & Starr, who are constructing the Cornwall St. Ry., owing to the increasing traffic, have ordered additional C. G. E. 800 motors from the Canadian General Electric Co.

The Dominion Oil & Supply Co., of Montreal, is applying for incorporation, to manufacture engine and boiler supplies, etc. Among the applicants are Tancred Hout and Paul Gailbart.

The Goldie & McCulloch Co., of Galt, have been given an order by the Galt Waterworks Department for a compound steam pump capable of pumping 1,000,000 imperial gallons per 24 hours.

The Paxton, Tait Co., of Port Perry, Ont., are seeking incorporation, with a capital stock of \$99,000. The first directors are Hon. John Dryden, George William Dryden and William McGill.

Messrs. B. Bell & Sons, agricultural implement manufacturers, of St. George, Ont., are having their large works lighted throughout by electricity. The Royal Electric Company are installing the plant.

The Montreal Park and Island Railway Company have recently placed an order with the Royal Electric Company for ten (two 30 h. p. motor) car equipments, and one 250 k. w. railway generator. These are to replace their plant recently destroyed by fire.

The Berlin & Waterloo Electric St. Ry. Co. have placed an order for two closed motor car bodies with the Canadian General Electric Co. These cars will be of the company's standard vestibule type, somewhat modified to meet the views of the president of the road, Mr. E. Carl Breithaupt, and are intended to be models both in design and construction.

La Compagnie Electrique has recently purchased a 30 h. p. S. K. C. two-phase motor from the Royal Electric Co. This motor will be used to operate a woollen mill. This installation is of special importance as showing the development of multiphase motor work in small plants, and how small plants can increase their earning capacity by operating in the day time as well as the short time of load at night.

The Corporation of the town of Newmarket have closed a contract with the Royal Electric Co. for one of their "S. K. C." alternating current dynamos, having a capacity of 1,000 16 candle power lamps; and also have ordered 800 light capacity in "S. K. C." transformers. They are re-building the old plant and are also installing a new arc machine and lamps, purchased from the Canadian General Electric Co.

The Royal Electric Company are installing for McMaster Bros., of Ridgeway, Ont., one of their 75 k. w. "S. K. C." transformers of 500 light capacity. The generator is direct belted to a 100 h. p. high speed Leonard Ball engine, making a very compact and modern plant. Their new brick power house is a model of neatness, and when their plant is completed they will have a fine modern and complete electric lighting plant.

Mr. Geo. E. Matthews, manager of the Electric Repair and Contracting Co., of Montreal, states that the results of the company's first year's business are very satisfactory, and they are entering upon the second year with fair prospects. The company are prepared to execute any class of new or repair work. The fact that Mr. Matthews was for ten years foreman of the repair department of the Royal Electric Co. should be a sufficient guarantee of competency.

The Montreal Cotton Co. are installing electrical power apparatus in their mill at Valleyfield. Mr. Louis Simpson, the general manager of the company, after examining the operation of similar

plants in the cotton mills in the United States, has placed an order with the Canadian General Electric Co. for a 600 h. p. three phase generator, and for 350 h. p. capacity in induction motors. Some of the latter will be of the inverted type attached to the ceiling and direct coupled to the line shafts which they are to run.

The Chateauguay & Northern Ry. Co. are proceeding rapidly with the equipment of their road, which is really a branch of the Montreal Island Belt Line system. The contract for the entire electrical equipment and for the car bodies has been awarded to the Canadian General Electric Co. and consists initially of one 200 k. w. multipolar railway generator, and two open and four closed cars equipped with C. G. E. 800 motors, and type "K" controllers. The road is expected to be ready for operation not later than September 15th.

UNSOLVED PROBLEMS IN THE MANUFACTURE OF LIGHT.

PROF. John Cox, in a recent lecture on the above-named theme, before the Royal Society of Canada, presented, in a very striking way the enormous percentage loss of energy in all attempts heretofore made to manufacture light through the agency of the steam engine.

To begin with he points out that in practice not more than from 7 to 16 per cent. of the energy of the fuel used can be realized through the engine, and theoretical considerations establish a limit at about 30 per cent., beyond which it would seem to be hopeless to expect to pass in any form of heat engine. This he terms one of the unsolved problems.

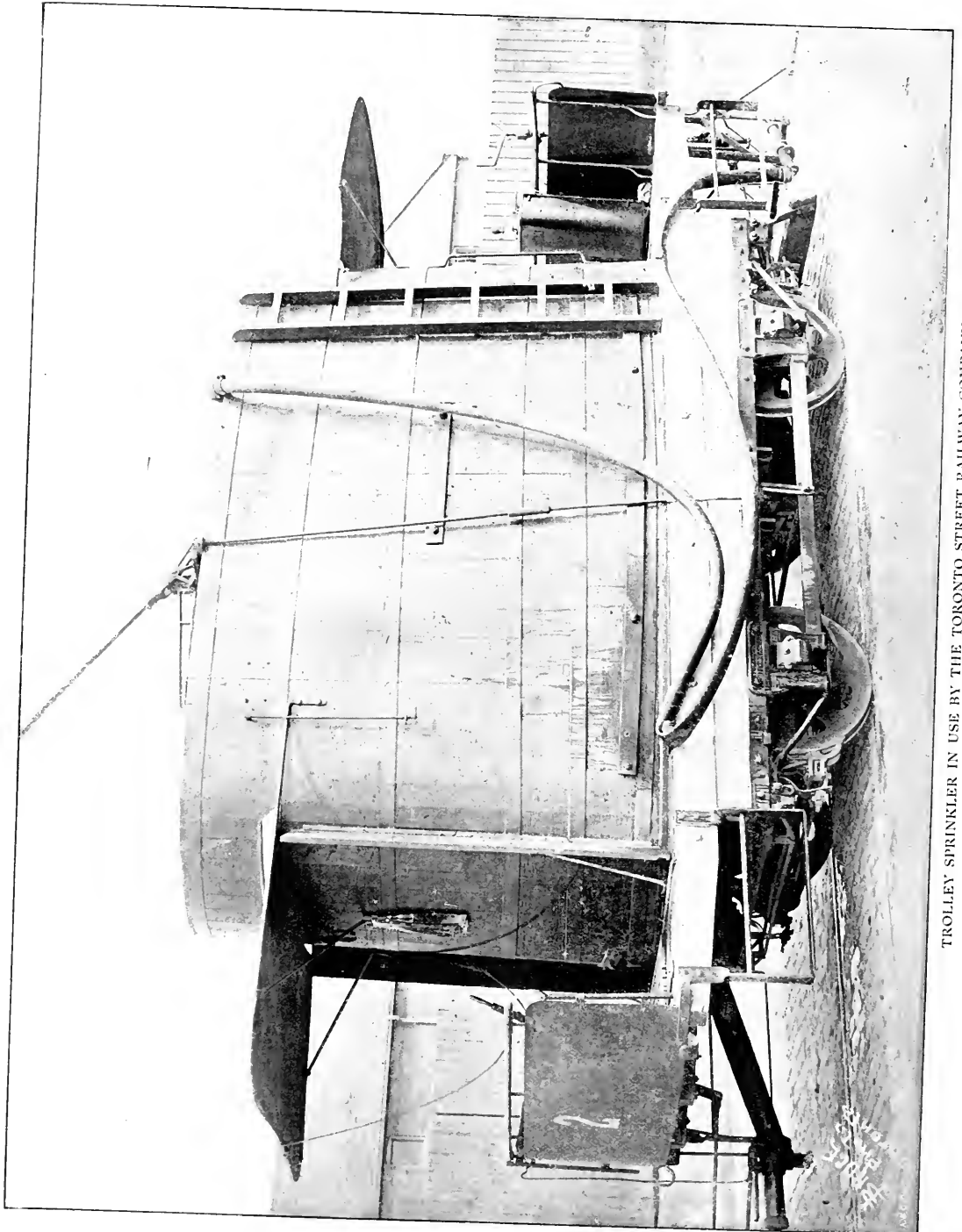
It is, however, not unsolvable if we can devise some means of extracting the energy of coal otherwise than by heat—say in some such manner as that in burning zinc in a voltaic battery. That this is not beyond the scope of our present scientific knowledge the recent experiments of Borchers and others bear strong evidence.

In the second stage of the operation of producing the electric light, the dynamo is already so nearly perfect that hardly any heat is lost in its conversion into current.

The third stage brings us to the lamp, with some 7 per cent. of the original energy still available. The only means thus far available for producing luminous energy is to heat the molecules of some substance, and in this operation we are compelled to waste the greater portion of our available energy in producing heat before we obtain the light rays.

"Here, then, is the second unsolved problem, since even in the incandescent lamp and the arc lamp not more than from 3 to 5 per cent. of the energy supplied is converted into light. Thus, of the original store in the coal less than three parts in a thousand ultimately become useful. In the last six years, however, some hint of means to overcome the difficulty has been obtained from the proof by Maxwell and Hertz that light is only an electric radiation. Could we produce electric oscillations of a sufficient rapidity, we might discard the molecules of matter, and directly manufacture light without their intervention. To do this we must be able to produce oscillations at the rate of 400,000,000,000 per second. Tesla has produced them in thousands and millions per second, and Crookes has shown how, by means of high vacua, to raise many bodies to brilliant fluorescence at a small expense of energy. . . . These are hints toward a solution of the problem, but give no solution as yet. Prof. Langley states that the Cuban firefly spends the whole of its energy upon the visual rays without wasting any upon heat, and is some four hundred times more efficient as a light producer than the electric arc, and even ten times more efficient than the sun in this respect. Thus, while at present we have no solution of these important problems, we have reason to hope that in the not distant future one may be obtained, and the human inventor may not be put to shame by his humble insect rival."

ELECTRIC RAILWAY DEPARTMENT.



TROLLEY SPRINKLER IN USE BY THE TORONTO STREET RAILWAY COMPANY.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VI.

OCTOBER, 1896

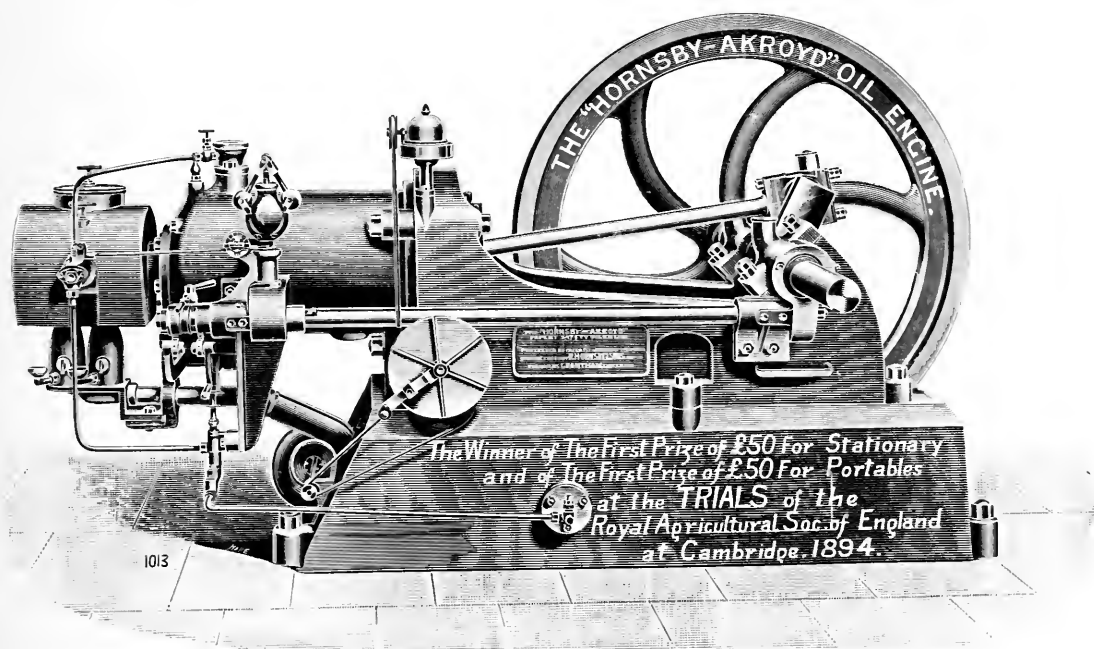
NO. 10.

THE HORNSBY-AKROYD OIL ENGINE.

THE Northey Manufacturing Company, Ltd., well-known throughout the Dominion as builders of high class pumping machinery, have lately entered upon the manufacture of a most decided novelty in Canada, in the shape of the Hornsby-Akroyd oil engine. This engine, as will be seen from the accompanying cut, is a very compact and simple machine, and one which will prove most useful in a great many situations in which

4th. The expulsion of the spent gases by the piston.

In starting the oil engine, the small lamp, fed by the same oil as is used in the engine, is lighted and placed under the vaporiser, which is the part immediately behind the cylinder proper. In about ten minutes the vaporiser is hot and the engine ready to start. The fly-wheel is turned by hand a couple of revolutions, to draw air into the cylinder, and the engine then works automatically, giving out power in exact proportion to



the steam engine is neither so convenient or so economical.

In the oil engine the power is produced direct from a low grade of petroleum, by internal combustion, without the intervention of a boiler or steam in any form.

The oil engine which the Northey Mfg. Co. is about to place on the Canadian market, works on what is known as the "Otto cycle," which may be briefly explained as follows:—

1st. The admission of atmospheric air into the cylinder during the forward movement of the piston.

2nd. The compression of this air during the backward movement of the piston and its intimate intermixture with the oil vapor, previously introduced into the vaporiser.

3rd. The expansion by combustion of the mixture of gas and air in the cylinder.

the work to be done, and running evenly and quietly without further attention, so long as the supply of oil is maintained. The consumption of oil is less than one pint per horse power per hour, and a cheap gas oil, first distillation, is used, costing $7\frac{1}{2}$ cents per gallon.

It will be noticed that the power in the oil engine is obtained from the expansion by combustion of a mixture of gas and air, and special attention is directed to the special safety from explosion or fire which the oil engine affords. The only fire while the engine is running is inside the cylinder, and the supply of oil is contained in a cast-iron receptacle in the bed, secure from all danger. There are no sparks, no smoke and no ashes.

Attention is also called to the ease and quickness of starting of this engine, and its great economy and safety from fire hazard. It may be used advantageously

wherever a steam engine can be used, and in many situations where a steam engine could not be used. For threshing it is specially useful, as no large supply of water is required, and the portable type is light and compact.

In combination with a pump it affords cheap and economical waterworks for towns and villages; and the engine may be used with excellent results for driving dynamos for lighting and other purposes. In fact, the special applications of the Northey Mfg. Co's. oil engine cannot be enumerated, but will readily suggest themselves to parties requiring power.

Prices and catalogues may be obtained from the makers, the Northey Manufacturing Company, Ltd., King street subway, Toronto, who will be glad to furnish estimates and information to all interested.

ROCKING GRATES.

In view of the rather adverse conclusion arrived at by the American Boiler Manufacturers' Association with regard to the advantage to be secured by the use of shaking furnace grates, the ELECTRICAL NEWS solicited the opinion of several well-known engineers on the subject. The opinions received are printed below. This subject, like any other which affects the fuel account, should have a particular interest for owners and operators of steam plant. We would therefore be pleased to see subjects of this character discussed from time to time in our columns.

Mr. A. E. Edkins, Toronto, on the eve of his departure for England, writes briefly as follows: "Re decision of American Boiler Makers' Association, and rocking grates, I have never yet seen a fireman use them to cause waste of fuel, but on the contrary, as a general rule, I find they do not operate them often enough. If the fuel is suitable, I believe the rocking grate to be a good thing and conducive to economy."

Mr. E. J. Philip, 11 Cumberland St., Toronto, writes:

"In reference to the advantages and disadvantages of shaking grates, many things may be said, from the fact that different people look at the same thing from different standpoints. A shaking grate may save money if properly designed and managed, or it may waste coal and be a bill of expense in repairs.

"A good shaking grate will save coal, increase the capacity of the boiler, and will reduce the work of the fireman; but to do this it must be properly designed for the work it has to do, and put in a properly proportioned furnace, and it must be carefully managed. If any of these requirements are neglected it will very likely fail to meet the expectations of the purchaser. Coal may not be saved, and yet the grates may be satisfactory if they accomplish what they were put in to do. I know of an instance in which a firm put in a shaking grate and their fuel consumption was increased, yet they were satisfied, because they wanted to be able to burn more coal and increase their capacity. In this case the grate was badly proportioned—the air space was very wide. In other places, under other conditions, this grate would have been condemned.

"In another place a new make of shaking grate was put in and an old stationary grate taken out. The new grate was to save 15%. When a test was made a loss of from 1 to 3% was shown. The grates are still being used and are satisfactory, in that they increase the capacity of the boiler and the work of firing is less.

"Against these cases may be cited two sets of shaking grates put in and the furnaces rebuilt and entirely altered, by which a saving of 11% was effected with the same coal (large egg) and a change to pea coal showed a saving in cost of 24%. A large percentage of this should be credited to the new furnaces. The old furnace and ash-pit was very low, and had far too large a grate area. The height of ash-pit and furnace was doubled and the area reduced nearly one-half. This is an exceptional case; it was not a boiler furnace.

"There are a number of shaking grates in the city that are giving good satisfaction and have shown a good saving. Where there is only one boiler and it has ample capacity, a good stationary grate is the best under most conditions, but if a fireman has much steam to make and a number of boilers to fire, a shaking grate will be found of advantage.

"It must not be forgotten that there are shaking grates, and shaking and dumping grates, with all sorts of combinations on both. The dumping feature is as a rule dangerous to the coal pile, and is often expensive in repairs in the hands of many firemen. This type of grate, however, may be used with advantage and economy in large plants, or when in charge of an unusually careful fireman.

"Under all conditions a grate of any description, to be satisfactory, should have the air space properly proportioned for the particular fuel to be burned. If a shaking grate, it should be designed so that it will not be likely to get out of order, and that, if a part is broken, it can be easily replaced without disturbing the entire grate. It should be put in a properly proportioned furnace. Lastly, it must be carefully managed. The furnace should be proportioned to the grade of fuel used. If all these conditions are complied with, coal will be saved and the capacity of the boiler increased, and the work of the fireman made easier.

"There is not enough thought and care used in building in a boiler, designing the furnace and selecting the grate. Nearly every furnace has some arrangement to save coal, increase the capacity or reduce the work, and yet where is there to be found a furnace that is entirely satisfactory in every respect? Discussions on labor and coal saving devices would bring out much information and would be of benefit to us all."

Mr. G. C. Mooring, Toronto, writes: "To my mind the main and best feature of the shaking grate bar was not touched upon by the American Boiler Makers' convention, (or at least was not reported), and that is the possibility of being able to clean the fire without having to open the furnace doors. If the fireman has too much steam he sometimes opens the furnace doors and the steam drops very suddenly. It takes from two to five minutes to clean a fire. Any thoughtful engineer or boiler maker knows what a great loss in fuel this causes, not to speak of the injury to the boiler. Throughout the whole discussion the main point against shaker bars is that the fireman does too much shaking. Is that the fault of the bars? I have seen great waste of coal from the same cause and from the coal being too fine for the mesh of the bars as well as from trying to burn hard coal dust without mixing some soft screenings with it, which latter method cokes and prevents much loss. I do not agree with Mr. Leonard, who says that shaker bars work best with poor fuel. If Mr. Leonard would try firing with the coal we get sometimes that melts and runs over the bars like iron—runs partly

through the bars until the cold air trying to get through chills it and it sticks there. Let him try to shake under these conditions, and he will wish those shaker bars in a still hotter place than they are. Shaker bars work best with good coal, either hard or soft. Ask locomotive engineers how they would get along these days without shaker bars. I think that the shaker bar has an advantage over the straight bar; still I would not recommend any firm to change unless the straight bars were burnt out. I do not recommend any particular shaker bar, but whatever the make, it should have as much air space as possible."

Mr. Geo. C. Robb, Chief Engineer of the Boiler Insurance and Inspection Co., Toronto, writes:—

"The best method of burning coal in a steam boiler is still an unsettled question, and likely to remain so. One reason for this is, that it seems to be impossible to get the best results out of a given quantity of coal, and at the same time, get the greatest amount of work out of the boiler in which the coal is burned. To get the greatest amount of steam out of a boiler is often a far more important matter for the owner than to get steam with the least possible amount of coal. Another reason why the question is so difficult of settlement is that there are so many varieties of coal, each requiring to be used in some particular way in order to get best results. The amount of air which should pass into the furnace, how much of it should go up through the coal, and how much should enter above the fire, form points of detail upon which great differences of opinion are found to exist. It will repay any one interested in the subject to make a study of the theory of combustion and then try to carry the theory into practice, and carefully note the results.

"The argument used by the American Boiler Manufacturers' Association seems to be rather a poor one. Supposing it were true that sometimes some unburnt coal did fall through because the fireman shook the bars too vigorously; that is an evil which can be easily remedied, and it is an evil of much less magnitude than having the furnace doors kept wide open while the vigorous fireman is stirring up the fuel and the cold air is rushing in, cooling off the boiler, and developing rivet cracks at the seam over the bridge wall.

"Shaking or rocking grates enable a fireman to keep the whole surface in better condition for the proper passage of air than can be done by stirring with slice bar in the hand. The fire can be shaken up without the doors being opened, except for the actual admission of the fuel. Fuel is wasted and boilers are injured by sudden changes of temperature in the furnace, and as shaking bars diminish the time when the furnace doors must be kept open, it follows that they must if properly used, both save fuel and prevent injury to the boiler. It is quite possible by sufficient shaking to dump the whole fire into the ash pit, but that would not be a fair way to use them, and if a fault, it should be laid on the fireman rather than on the grates.

"It may be taken as proved, that economy in fuel in a steam boiler is promoted by burning the fuel at as high a temperature as possible, by keeping that high temperature as uniform as possible, and by having the rate of combustion as regular as possible. Mechanical stokers, rocking grate bars and other appliances help a fireman to keep a furnace in these conditions and hence, unless there be other objections to their use, it would seem that they should be more used than they are."

LONG BURNING ARC LAMPS.

A RECENT innovation in arc lighting practice which has already attracted considerable attention from central station managers as well as the manufacturing companies is the "long burning arc lamp." A recognized objection to the use of the arc lamp for general illumination has been the cost of the carbons and the daily expense involved in their renewal. An additional drawback has been the inadaptability of the existing arc lamp for candle powers lower than those which obtain for ordinary street lighting service.

A very simple, and it is claimed satisfactory arc lamp with enclosed arc for "long burning" service has been placed upon the market recently by the Canadian General Electric Company. Among the principal features of value claimed for a lamp of this type may be noted briefly the following: It requires very little attention, and therefore the expense of trimming is greatly reduced; it is independent of other lamps on the same circuit, and may be cut in or out without affecting them; it does not cast deep shadows; it is artistic in appearance and compact in design, having a self contained resistance.

Two classes are being made at present, burning with one trimming 100 hours and 150 hours respectively. The former is about 37" and the latter about 46". Both are made with three different styles of finish as follows: Plain back japan finish; ornamental dull black ebony finish, and ornamental polished brass finish.

The standard lamps are made for 5 amperes and can be adjusted to take from $4\frac{1}{4}$ to $4\frac{1}{2}$ amperes if desired. Lamps of smaller amperage can be furnished if so ordered. Lamps for 3 to $3\frac{1}{4}$ amperes are not considered impracticable, but small carbons should be used. All lamps are carefully adjusted and tested at 110 volts before shipment.

The mechanism is extremely simple, consisting of a pair of magnet coils, the armature of which carries the clutch and controls the feeding device, the clutch being perfectly positive, and at the same time feeding with the utmost delicacy. In order to meet the varying conditions of line voltage, an adjustment for the voltage at the arc is provided in the resistance at the top of the lamp. Changing this resistance varies only the length and potential of the arc and not the current strength. The method of securing the inner globe and lower carbon is very simple and effective, rendering it convenient for trimming and cleaning. The inner globe completely encloses the arc. This is designed to increase the life of the carbons, by excluding the air and thereby preventing combustion. The outer globe holder is a new, patented, self-locking device which is very convenient and perfectly secure. The globe is supported at all times from below and when lowered for trimming the top of the globe is level with the bottom of the frame, rendering the lower carbon holder accessible.

The use of high grade, solid carbons is necessary to prevent undue coating of inner globe to give satisfactory service. As there is more or less variation in the size of $\frac{1}{2}$ " carbons, the opening of the cap of the inner globe is .525" diameter, and the carbons used should come within the following limits: .520" max. diam.; .505 min. diam. The opening or space between the cap and carbon should be only sufficient to allow the free passage of the carbon as it feeds downward. If air is allowed to enter the inner globe the life of the carbons is greatly shortened. Attention should be given to

polishing and cleaning the carbon rod at every trimming, to prevent its becoming sticky from atmospheric conditions. With solid "electra" carbons, which have been found to give the best results, a potential of 75 to 80 volts at the arc is required.

When these lamps are properly trimmed with correct lengths of carbons, more than the rated time of burning can be expected. They will not need further attention through an entire run, and will cut out properly when the carbons are consumed. In most cases the piece left in the upper holder is of correct length for the lower holder for the next full run.

A further desideratum is a lamp equally simple and effective adopted for use on alternating circuits. Such a lamp is promised and indeed assured by experimental work as a development of the immediate future.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

KINGSTON ASSOCIATION NO. 10.

At the last regular meeting of the above association the officers for the ensuing year were installed as follows: Past President, S. Donnelly; President, F. Simmons; Vice-President, J. Tandvin; Treasurer, C. Selby; Secretary, A. Macdonald; Doorkeeper, R. McDonald; Conductor, R. Bajus; Trustees, John L. Orr and S. Donnelly. Letters were read from delegates to the recent annual convention of the C.A.S.E., expressing their appreciation of the hospitality extended to them.

BROCKVILLE ASSOCIATION NO. 15.

Mr. J. Aikens, Recording Secretary of this association, reports that since the Kingston convention some very interesting instruction meetings have been held, at which there has been a good attendance of earnest workers. At these meetings the blackboard has been in constant use for purposes of illustration. In the unavoidable absence on some occasions of the President, Bro. Franklin, the Past President, Bro. Chapman, gave the members the benefit of his assistance in solving the problems under discussion.

ONTARIO ASSOCIATION STATIONARY ENGINEERS.

TORONTO, Sept. 11, 1896.

To the Editor of the ELECTRICAL NEWS.

SIR,—The following engineers have recently passed their examinations: Third class—Geo. H. Bull, Rosemeath; Chas. Kemp, Petrolea; A. Ritchie, Orillia; C. Labarge, Hull, P. Q.; J. Radmore, Buckingham, P. Q.; Fred. Nagle, Paris; J. Carol, Hamilton; Albert Martin, Toronto; F. C. Corrie, Stratford; D. Anderson, Mt. Forest; J. Wilson, Hamilton; Geo. E. Bower, Lucknow; Geo. H. Cooper, Oakville. Second class—D. H. Vincent, Belleville; B. Deo, St. Thomas; Thos. R. Seaton, Toronto. In all twenty engineers wrote for examination, four of whom failed, either through not having had the required experience or other cause.

Enquiries are coming in daily from all parts of the province concerning examinations, which goes to prove that the feeling is growing, viz., that all engineers should hold certificates.

The city council of Hamilton have decided that no engineer shall be employed by that corporation unless he hold an Ontario certificate. This is a move in the

right direction and might well be followed by our city council in Toronto.

There are about forty certificate holders who have not paid their renewal fees so far this year, and I shall be glad if they will return old certificates, either with or without renewal fees, as the certificates are the Board's property and must be returned to this office when expired.

I shall be glad to send information regarding examinations to any engineer desiring same on receipt of post card giving name and address.

Yours truly,

A. E. EDKINS, Registrar.

Office, 88 Caroline St., Toronto.

BURSTING STEAM PIPES.

The explosion of steam pipes has been occurring lately with such frequency as leads one to ask, Why? As a general thing a steam pipe is stronger for the pressure it has to carry than is a steam boiler, and yet they explode, showing that some force is at work which produces a weakening effect on the pipe. A long line of steam pipe is difficult to keep tight unless some special arrangement is employed that will allow, not only for expansion and contractions but other strains to which the pipe is subjected.

There are few engines that run so steadily but what they cause vibration of the steam pipe and in some cases the vibration becomes so great that it is necessary to use extra braces or stays to prevent its going beyond limits. Constant vibration of metal under strain is known to have a tendency towards producing crystallization, and this is probably what results in some steam pipes.

KEEP AT IT.

If you expect to conquer
In the battle of to-day,
You will have to blow your trumpet
In a firm and steady way.
If you toot your little whistle
And then lay aside the horn,
There's not a soul will ever know
That such a man was born.
The man that owns his acres
Is the man that plows all day;
And the man that keeps a humping
Is the man that's here to stray.
But the man that advertises
With a sort of sudden jerk,
Is the man that blames the printer
Because it didn't work.
But the man that gets the business
Uses brainy printers' ink,
Not a clatter and a sputter,
But an ad. that makes you think;
And he plans his advertisements
As he plans his well-bought stock,
And the future of his business
Is as solid as a rock.

ERRATUM.

NEW YORK, Sept. 22, 1896.

To the Editor of the CANADIAN ELECTRICAL NEWS.

DEAR SIR,—I beg to call attention to an error (probably a misprint) which appears in your paper for September. In the column headed "Electrical Items worth Remembering," there appears: "The resistance of copper rises about 0.21 per cent. for each degree centigrade," which should read "0.21° F."

Respectfully yours,

V. M. BENEDIKT, E. E.,

27 Thames st., New York.

DEFINITIONS OF ELECTRICAL TERMS.

ACCUMULATOR.—Storage or secondary battery, in which electricity has been carried and has been converted into chemical energy, being retransformed into electricity when the battery is put to use for the purpose of furnishing energy or light.

AMPERE.—The unit of strength of the current per second. It represents, perhaps, the volume of electricity, and its value is the quantity of the fluid which flows per second through one ohm of resistance when impelled by one volt of electro-motive force.

ANODE.—The positive pole of a battery.

ARC.—The space between the points of the carbons in an electric light or lamp which is bridged by the current represented by the flame.

ARMATURE.—The revolving arm of an electric generator.

BATTERY.—A primary battery is one in which electricity is obtained through the decomposition of metals in chemical solutions. Zinc and copper may be the metals and sulphuric acid the chemical. Gold, silver, platinum, iron or tin may also be used as the metals and sal-ammoniac, bi-chromate of potash, nitric acid and sulphate of copper may also be used as the chemicals. The storage battery is a cell of acidulated water, containing, for example, plates of lead. This arrangement has an electric current directed into it, which it will give back in almost an equal quantity when the energy is wanted. There are various methods and ways of making both primary and secondary or storage batteries, but the above are the general principles governing their construction.

BRUSH.—The copper string which connects with the commutator of a dynamo and gathers the electricity for the conductors.

CANDLE.—Our unit of illuminating power.

CARBONS.—Rods of carbon are used in arc lights for first establishing the current, and then, when withdrawn, form the arc over which the electric flame leaps. They are made of powdered coke by a secret process.

CELL.—The vessel in which chemical action produces electricity.

CIRCUIT.—The path along which an electric current travels.

COMMUTATOR.—The collector of the electricity generated, and from which the fluid is taken by the brushes.

CONDENSER.—An arrangement for collecting a large quantity of electricity on a small surface.

CONDUCTIVITY.—The comparative ability of a substance to convey a current of electricity.

CONDUCTOR.—Conveyors of the electric current, silver being the best, and copper next, in conductivity.

CORE.—The iron that becomes magnetized in an electro-magnet. In helix, this iron is of the softest kind.

COULOMB.—The unit of dynamic quantity represented by one ampere of current.

CURRENT.—The flow of electricity along a conductor. Its strength in amperes is found by dividing the electro-motive force in volts by the resistance in ohms.

A WORD OF PRAISE.

MR. B. A. YORK, Secretary of Montreal Association of Stationary Engineers, writes the publisher of the *ELECTRICAL NEWS* as follows:—"At our regular meeting your paper received much praise for the way you had so ably and fully reported all that took place at our last convention, and I will take opportunity to thank you and wish your paper every success."

THE ADVANTAGES OF VERTICAL ENGINES.

The great increase in the use of power for the generation of electricity in large quantities has served to develop large stationary engines, and as such plants are usually in thickly populated districts, where land or floor space is expensive, the vertical engine has received the preference to a great extent; for a given power it occupies less floor space than any other type. For the same rotative speed and power the cost of building such engines is about equal, whether the vertical or horizontal type is used, but, as builders become used to designing the vertical engine, I think the first cost will be in favor of this type.

As to accessibility for repairs and care in running, there is little to choose between them, but with a properly rigged overhead travelling crane I think the matter of overhauling the vertical is the easier, whereas in running it is doubtless more convenient to have everything on one level.

In the matter of friction the vertical engine, too, has a great advantage, as the packing, besides its appropriate office of preventing steam leakage past the piston, has only to guide it also, whereas in the horizontal engine it must not only support the entire weight of the piston, but also the pressure of steam, as the "bull ring" generally fits the bottom half of the cylinder steam tight, but allows the steam to enter on top as far as the packing ring.

In the vertical design the weight of the cross-head does not increase the slide friction, which is not the case with the horizontal engine when running, with the crank passing the upper arc as the piston goes toward the shaft; and when the reverse direction is used, although the slide is relieved of the weight of the cross-head, a worse trouble is introduced, namely, the slapping up and down of the cross-head at each end of the stroke.—Charles H. Manning in *Cassier's* for October.

SPECIALIZATION IN ENGINEERING.

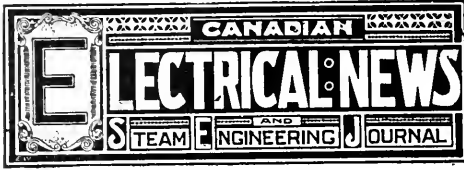
THE civil engineer of past generations, who was supposed to command a comprehensive knowledge of every branch of engineering then practiced, from the design of a steam engine or machine tool to that of a bridge or city drain system or complete waterworks plant, has virtually ceased to exist, and in his stead, says a writer in *Cassier's Magazine*, we find the steam engineer, the sanitary engineer, the bridge engineer and the engineer of various other subdivisions of the great field of engineering, each an expert in his particular line. It has been found impossible for one man to combine within himself the detail knowledge necessary to practice all these branches with entire success. One branch alone is almost sufficient to make a life study, and the engineering specialist of to-day finds himself busily enough occupied in keeping abreast of the times.

Messrs. John Starr, Son & Co., Halifax, have just installed a 50 light plant for the St. Croix Paper Mills Co., of Hartsville, N. S.

F. Stanciliffe, of Flat Lands, N. B., has had a 50 light plant installed in his shingle mill. This plant was supplied and installed by John Starr, Son & Co., of Halifax, N. S.

Messrs. John Starr, Son & Co., Halifax, have recently installed a 200 light plant for Kilgour Shives, of Campbellton, N. B. This is used for lighting Mr. Shives' extensive lumber mills and yards.

The "Unique" telephones as manufactured by John Starr, Son & Co., Halifax, are having a large sale. This firm have recently supplied a number of telephones and switchboards to Campbellton and Quebec, both of which orders were "repeats" which speaks well for the "Unique" telephones which have now been on the market for several years.



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. John Fox, President; Chas. Moseley, Vice-President; T. Eversfield, Recording Secretary, University Crescent.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, John Murphy; 1st Vice-President, J. E. Huntington; 2nd Vice-President, Wm. Smyth; Secretary, E. Archibald York; Treasurer, Peter McNaughton.

ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. R. Drouin, President; Alfred Louton, Secretary, 306 Delisle street, St. Cunezonde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month, in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Macabee's Hall. Wm. Norris, President; E. Teeter, Vice-President; Jas. Ironsides, Corresponding Secretary.

STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. J. B. Forsyth, President; Jos. Ogle, Vice-President; T. Pilgrim, Continental Corresponding Secretary.

LONDON BRANCH NO. 5.—Meets once a month in the Huron and Erie Loan Savings Co.'s block. Robert Simmie, President; E. Kidner, Vice-President; Wm. Meaden, Secretary Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30 p.m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Horbridge's hall, Rideau street; Frank Robert, President; F. Merrill, Secretary, 352 Wellington street.

QUÉBEC BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. J. R. Utley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King street, at 8 p.m. President, F. Simmons; Vice-President, J. W. Tindvin; Secretary, A. Macdonald.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

WIARTON BRANCH NO. 13.—President, Wm. Craddock; Rec.-Secretary, Ed. Dunham.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outhwaite, President; W. Foster, Vice-President; A. E. McCullum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening. President, Archibald Franklin; Vice-President, John Grundy; Recording Secretary, James Atkins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

THE electrical congress held at Geneva

The Geneva Congress in August, was poorly attended. Notwithstanding that representatives were not present from many of the leading scientific societies of the world, including the British and American Institutes of Electrical Engineers, the Congress felt no hesitation in rejecting the magnetic units sanctioned by the American Institute, and adopting a system of photometric units.

At a convention of street lighting officials held recently at New Haven, a bad showing was made on behalf of municipal control of electric lighting plants. The statement was made that Wabash, Ind., purchased a plant for \$18,000 and sold it for \$30; Xenia, O., paid \$35,000 for a plant and ten years later sold it for \$10,000; Moline, Ill., bought a plant at \$15,000 and four years after sold it for \$8,000; Michigan City bought a \$10,000 plant and sold it for \$2,500.

The Telephone Situation.

THE agreement entered into five years ago between the Bell Telephone Company and the City Council of Toronto, is about to expire. Under this agreement five per cent. of the receipts of the Toronto exchange were to be paid into the city exchequer and the yearly rental was decreased from \$50 to \$45 per instrument for commercial use. The Telephone Company have notified the Council that they will decline to renew the agreement, and it is said to be their intention to increase the rental of their instruments when the period of the present arrangement shall terminate. The Council have invited tenders for the franchise, but are understood to have had no offers. Representatives of the Strowger automatic telephone have, however, set up several of their instruments in the business part of the city with

the purpose of demonstrating their utility. Appearances would seem to indicate that the Bell Telephone Co. are likely to remain in control of the situation in Toronto unless dislodged by the less expensive method which Prof. Bell is reported to have discovered of transmitting messages by means of a ray of light.

Those Alleged Portraits.

MESSRS. A. M. Wickens, A. E. Edkins, and John Fox, have for many years been among the most intelligent and

hard-working promoters of the prosperity of the Canadian Association of Stationary Engineers. Presumably in recognition of their self-sacrificing efforts, they find themselves depicted in the columns of the Canadian Engineer as "the villains in the play," or as a couple of crackmen who have just finished a term in the strong institution at Kingston and are on the look-out for another job.

The Feed Water of Water Tube Boilers.

In the case of the recent explosion of a water tube boiler in England, the Board of Trade stated the cause to have been the closing of the down-take tubes by calcareous deposit. The stoppage of the circulation due to this deposit caused undue expansion of the horizontal tubes and placed such a severe strain on front and rear cast iron headers, as caused their fracture. Forged steel is now being substituted for cast iron in headers in some boilers of this description. Notwithstanding, there would still appear to be an element of danger where pure feed water cannot be obtained.

Three-Cent Fares.

THE universal demand for cheapness has led to an agitation for a reduction of the street car fare to three cents. Mr. H. A. Everett, formerly of Toronto, now the principal owner of the new electric street railway at Detroit, Mich., was one of the few men in the business who believed that it would be to the advantage of the companies to offer a three-cent fare. He reduced the fare accordingly, but the results have not justified the wisdom of the step, and a return has been made to the former price. Especially in view of the serious inroads which the increasing use of the bicycle is making in the business of city roads, any reduction in the present fares is out of the question.

Insurance Against Accident to Electrical Machinery.

THIS is the day of electrical enterprise. Every day new concerns are started, new machinery introduced, new methods invented; machinery and apparatus are being continually improved and cheapened, and the man who neglects to read neglects his own interests. Enterprises are being organized in every direction, which have for their object the lowering of prices of supplies, machines, etc., and among the latest that we have heard of is one for the insuring of electrical machinery against loss by accident, and against repairs. This seems to be a most valuable business, for electrical men cannot tell when their engines, or armatures, transformers, or motors may break down and require expert attention. The fact is that there is a most unsatisfactory amount of old and out of date apparatus being operated in central stations, the repairs on which must amount annually to a considerable sum, and any arrangement which will permit of the owners being

guaranteed against ruinous accidents ought to pay both the owners and the guarantors. Besides which, a company of experts who make it their business to keep plants in efficient working order will be a great boon to those whose acquaintance with electrical matters is limited.

Electricity in Photography.

WE are constantly being astonished by the multitude and variety of the purposes to which electricity is being adapted. One of the latest and most wonderful is to be seen in connection with the cinematograph now on exhibition in Toronto. By means of this instrument, which is the production of a French inventor named Lemaire, pictures in which the activities of living creatures and of nature are reproduced with the utmost fidelity, are thrown upon the canvass. Electricity has made it possible to take a series of photographs of objects in motion with such lightning-like rapidity, that when the photographs are placed side by side together and passed through the cinematograph, there is presented to view a reproduction of the whole scene as it appeared to the eye of the original beholder.

Shaking Furnace Grates.

THE American Boiler Manufacturers' Association, at its recent convention, discussed at some length the relative advantages and disadvantages of shaking grates. The conclusion arrived at was, that owing to the disposition of firemen to do too much shaking, an unduly large percentage of coal is dropped through the grate into the ash-pit. This would appear to be the fault of the fireman rather than of the grate. There are a great many costly fuel-saving devices on the market at the present day, for most of which large claims are made. It is highly desirable that those who have had practical experience in the use of any of these devices, should make known for the general welfare of owners and operators of steam plants, how far these claims are capable of being realized. We would take it as a favor if any of our readers who have had experience with shaking grates and suchlike modern devices, would write us their opinion of them.

Steam Turbines.

A CLASS of steam plant is now forcing itself on the notice of the electrical operating interest that presents many most interesting points and is well worthy of careful investigation. We allude to the machines known as "steam turbines." There are two of these that are well, and we may say favorably known to those who keep a place on the advance guard of electrical progress. The first is the Parsons, and the second the DeLaval steam turbine. In both the principle is to take advantage of the tremendous impact force of steam escaping (under pressure) from the boiler, to turn what may be termed a wheel with little discs or fans placed on its periphery. In this aspect, steam turbines are analogous to the Pelton and other impact turbines that rely for their turning moment more on impact than on static pressure. The tests on these turbines shew a very high degree of efficiency, the comparison being somewhat as follows: A single cylinder non-condensing high pressure engine will require about 30 lbs. of steam to maintain a horse power. A compound (two expansion) engine of superior make will require about 21 lbs. condensing; but some most extensive and apparently

competent tests on a DeLaval steam turbine give a consumption of a little over 18 lbs. per horse power, which is an uncommonly good showing, and one worthy of attracting the attention of the electrical profession. These machines revolve at a very high rate, and of course require most careful construction. Hitherto they have been connected to special dynamos through gearing, but in the near future, no doubt, they will be equally well adapted to belt connections. We strongly advise all electrical men to watch their development.

THE city of Montreal has announced its purpose to hold an International Exhibition in 1897 or the year following. Toronto also gives notice of its intention to hold a Dominion Exhibition next year. Toronto claims it was first in the field, and says it doesn't want to undertake an International Exhibition, and asks Montreal to defer the larger enterprise for a year or two. Montreal replies that the holding of a Dominion Exhibition in Toronto next year would seriously impair the chances of an International Exhibition a year or two later. Both cities have applied to the Dominion and Provincial governments for aid. Both have admitted that without such aid they cannot hope to make their scheme a success. Therefore, the decision as to which of the enterprises shall go forward at the present time would appear to rest with the government, unless, as we trust will be the case, a satisfactory arrangement can be reached between the representatives of the two cities.

Efficiency of Transformers.

In his valuable paper on "Some Central Station Economies" presented to the Canadian Electrical Association, Mr. P. G. Gossler makes a very conclusive showing as to the amount of saving which it is possible to effect by substituting for old-style transformers modern high efficiency apparatus. He instances a case in which the saving thus effected was sufficient to pay the cost of the new transformers within a period of less than three years. Mr. Gossler is authority for the statement that the efficiency of transformers varies from 50 to 100 per cent. If this statement be correct, and we judge it to be so, then there is need of the exercise of greater knowledge and skill on the part of some of the manufacturers of transformers in order that their production may be brought nearer up to the standard of machines of the highest efficiency. In other classes of electrical apparatus such a wide variation in efficiency does not exist, nor should it be allowed to continue in an instrument with functions so important as those of the transformer.

Specifications.

WE have had the advantage of seeing the specifications on which a number of electric lighting plants have recently been purchased, and have been struck by their laxity, and generally vague nature. In many cases—in most of them, in fact—it seemed as though special stress was laid on comparatively unimportant matters, whereas those points on which should really depend the selection of machinery were either not alluded to at all, or received only the most cursory notice. We have particularly in mind an arc plant specification which called for "a plant of 50 light nominal 2000 c. p. capacity with lamps, etc.," and then it went on to state that the candle power would be tested, and must be as specified.

Now, in the first place, what is the actual candle power of a nominal 2000 c. p. lamp? and is that actual candle power to be tested in the horizontal plane, or in any other plane making an angle with the horizontal? There was no efficiency requirements—no maximum temperature limit and the only really onerous condition was that the plant would have to operate to the satisfaction of the engineer, who, by the way, knew just enough about electrical apparatus to carbon the lamps. In another case a 60 k. w. alternator was called for. There was no specification as to voltage, maximum line loss, temperature limits, efficiencies, or any important feature of a machine, but it was clearly stated that the machine would be required to carry its full rated load for 24 consecutive hours, without undue heating (sic) in any part. What is "undue heating"? May the limit be placed at 200° F or 50° F, or where—and who is to fix it? Furthermore, what man in his senses is going to run a machine, in a small town, for 24 hours, in ordinary practice? If the machine is ever required to carry its full load for more than four hours at a time, that is all that it would ever be called on to do. And yet this same specification that left the alternator and transformer to the mercy of the contractors in every important point, imposed the most rigorous and minute conditions as to how the poles were to be placed—their size, and how many times they were to be painted, and the exact color, finishing up consistently by neglecting to say how many were required. Is this the way to buy machinery? Persons who throw themselves on the mercy of contractors by making specifications of the above description are laying themselves open to all kinds of deception and trickery, and only deserve to be taken in. The electrical market is full of machinery, good and bad and medium, and of course a purchaser is entitled to choose which he prefers, but carelessly or ignorantly prepared specifications impose rigorous conditions only on those manufacturing companies that will not condescend to sell poor apparatus, and leave every loop-hole of escape to those second-rate concerns that trade upon the inexperience of a credulous and penurious public.

EXPANSION OF BOILERS.

In a communication upon the above subject presented before the American Boiler Manufacturers' Association, by Mr. Fred Leonard, of London, Ont., the author said that during the last year an opportunity was offered to measure carefully the expansion of a stationary boiler bricked in and a small locomotive boiler mounted on skids, and it would appear that the expansion amounts to very little. The stationery boiler was 60 inches in diameter, 12 feet long, and stood three days, being cleaned and washed out. On the fourth day it was steamed up with a working pressure of 90 pounds, and a difference only of $\frac{1}{4}$ of an inch could be seen in length when standing cooled off and steam on. The locomotive boiler was 34 inches in diameter, 12 feet 9 inches long and carried 95 pounds steam, measured only $\frac{1}{4}$ inch less after having the water drawn off and standing 24 hours. From this it would appear that the plates and rollers under the brackets are unnecessary, as $\frac{1}{4}$ inch expansion in 12 feet amounts to practically nothing.

By request Mr. Leonard explained that the measurements were made on the return tubular boiler by means of a rod with a hook on the end which should be shoved through the tubes to the back connection.

PEMBROKE ELECTRIC LIGHT COMPANY.

THE composition of the Pembroke Electric Light Company is as follows: President, Hon. P. White; Vice-President, A. Foster; Directors, Geo. Smith and Alex. Miller.

The building is an L shaped structure, 52 x 40 feet, in which the plant is situated, the boiler room being situated in the smaller part. The building is of brick, with a steep roof, and is situated on the banks of the Madawaska river, convenient for condensing purposes.



MR. J. A. THIBODEAU.
Manager Pembroke Electric Light Company.

The C. P. R. track passes within a few feet of it, and coal is easily handled.

In the dynamo room two Wheelock cut-off condensing engines operate the machinery; one of them is a tandem compound of 110 h. p., the other of 128 h. p. These engines are belted to 40 feet of 4 in. shafting, from which is run a Royal alternator of 1000 lights, two Edison three-wire system generators and two 25 light Western arcs, all of modern design. The switch board is 11 x 18 feet, and is fully equipped with all necessary instruments. On the shafting are two Goldie & McCulloch clutch couplings, which permit the engines to run separately or together.

The boiler room is 22 x 30 feet, and contains two Goldie & McCulloch boilers of 100 and 70 h. p. respectively, fired by wood. Two Northey condensers in the dynamo room supply them through two Austin heaters.

The company was organized in 1880, and three years ago erected the building, an illustration of which appears on this page.

Mr. Thibodeau, the manager, whose portrait appears herewith, is a shrewd business man and is connected with many other enterprises in the town.

The plant is in charge of Mr. A. Cone, electrician, and Mr. Thos. Mackie, engineer.

The Hull and Aylmer Electric Railway Co. have purchased a park a mile and a half further up Deschene Lake than the present park at Aylmer. The park has a frontage of nearly half a mile on the lake. It is said to be the intention of the company to double track the road from Hull, and to purchase another locomotive and ten 40-foot trailers for handling excursion parties. A Ruggle's rotary snow plough has also been ordered.

BY THE WAY.

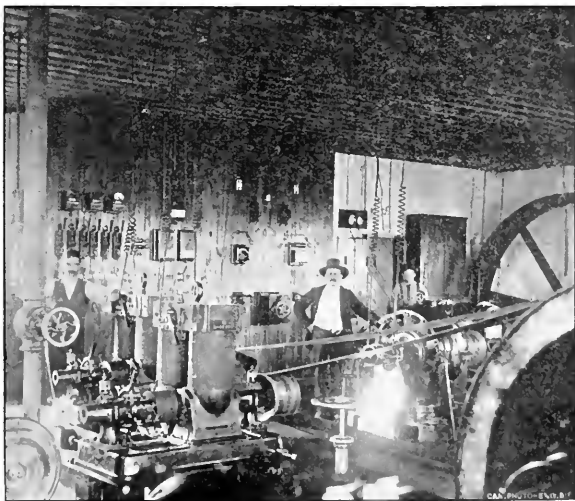
A NOVEL cause of dispute has arisen between the City Council of Toronto and the Toronto Railway Company. Under its agreement the Company pay mileage fees to the city on the pavement between their tracks. The point in dispute is whether curves and intersections should be included in the mileage pavements. The city argues yes, and the Company, no. The latter quote the opinion of Mr. W. T. Jennings, late City Engineer, who drafted the engineering clauses of the agreement, in support of their contention. If the curves and intersections are to be counted in, the Company will be required to pay \$4,000 per year additional mileage.

x x x x

THE city of Detroit rejected the offer of the Detroit Electric Light & Power Co., to furnish light at \$102.20 per lamp per year, and went into the business as a municipal enterprise. The sum of \$630,141.92 was invested in the plant. A report of the first nine months' operations has just been published, by which it is shown that it has cost the city \$68.52 per lamp, exclusive of any allowance for depreciation, interest on investment, water, rent and insurance. If these items are taken into account, as they certainly ought to be, and counting in also the amount which would have been received in taxes from a private lighting company, the actual cost per lamp is shown to be upwards of \$130 per year, or more than \$25 per lamp per year in excess of what a private concern offered to supply the light for.

x x x x

THE State of Ohio, following in the wake of New York state, has recently placed upon its statute books a law which makes electricity the instrument by which in future the death penalty is to be inflicted. The prison



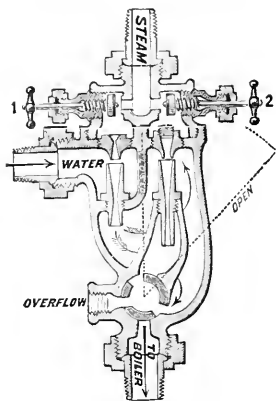
PEMBROKE ELECTRIC LIGHT COMPANY DYNAMO AND ENGINE ROOM.

official whose duty it was to purchase the required electrical apparatus for this purpose is said to have made the round of the electrical supply companies in Chicago and found that not one of them was willing to sell a dynamo to generate current to stop the current of human life. He had previously visited New York with the same result. The New York State authorities are said to have met with the same difficulty, and were finally obliged to buy their apparatus through a second

party. The above circumstance would appear to indicate that there is not yet a complete divorce between business and sentiment. The electrical fraternity have, no doubt, also felt it to be their duty not to assist to accentuate the idea which the daily press had succeeded in instilling into the minds of the people that the use of electricity was attended with the greatest possible danger to property and life.

THE "NIAGARA" INJECTOR.

Below is a sectional cut of the "Niagara Injector" an injector which is rapidly becoming popular among steam users. This boiler feeder is manufactured in St. John, N. B., by W. H. Stirling. The machine has only been on the market one year and is now in actual use in most of the cities and towns throughout Canada.



THE NIAGARA INJECTOR.

The machine is complete in itself requiring no valves as will be seen by the cut.

It can be throttled by means of valve No. 1 on suction side, so as to supply from full capacity down to required quantity, thus reducing the quantity of steam used, and delivering the water 90° hotter. The manufacturer states that this feature will save the price of the injector many times over in fuel alone, and that this fact has been demonstrated beyond doubt by the "Niagara" Injector being connected where other machines have been taken off.

Mr. Stirling has shipped these injectors to nearly every western city in Canada as far west as British Columbia.

The "Niagara" Injector is sold in Montreal by Samuel Fisher, 57 Sulpice street, and other dealers.

SPEED OF PULLEYS.

The diameter of the driven being given, to find its number of revolutions: Rule—Multiply the diameter of the driver by its number of revolutions, and divide the product by the diameter of the driven; the quotient will be the number of revolutions of the driven.

Ex. — 24in. diameter of driver \times 150, number of revolutions = $3,600 \div 12in.$ diameter of driven = 300.

The diameter and revolutions of the driver being given, to find the diameter of the driven, that shall make any given number of revolutions in the same time: Rule—Multiply the diameter of the driver by its number of revolutions, and divide the product by the number of required revolutions of the driven; the quotient will be its diameter.

Ex.—Diameter of driver (as before) 24in. \times revolutions 150 = 3,600. Number of revolutions of driven required = 300. Then $3,600 \div 300 = 12in.$

The rules following are but changes of the same, and will be readily understood from the foregoing examples.

To ascertain the size of the driver: Rule—Multiply the diameter of the driver by the number of revolutions you wish to make, and divide the product by the required revolutions of the driver; the quotient will be the size of the driver.

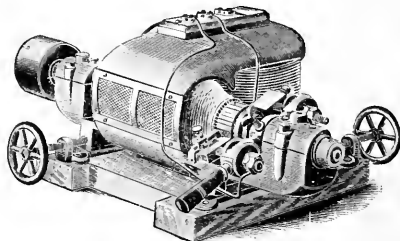
To ascertain the size of pulleys for given speed; Rule—Multiply all the diameters of the drivers together and all the diameters of the driven together; divide the drivers by the driven; the answer multiply by the known revolutions of main shaft.

THE NEW KAY MOTOR.

This motor was designed to meet the increasing demand for small power, and they are made in sizes from $\frac{1}{2}$ h.p. up to 10 h.p., the object being to produce an efficient, durable and cheap machine. There is only one joint in the magnetic field, therefore the loss in the magnetic circuit is scarcely perceptible. The bearings are self aligning and self oiling, having a metal ring at each end to carry the oil on to the shaft from the collar below. These bearings are made of the best phosphor bronze that can be had, in fact all the material used in the construction of the machines is of the best and the workmanship unsurpassed.

These machines have been tested in different places by expert electricians and they claim that they are as high in efficiency as any others they have tested and higher than a good many. The simplicity of their construction enables the firm to put them on the market at a very reasonable price. Every machine that is turned out is tested up to its full capacity and guaranteed against all electrical and mechanical defects for two years from the time they are started. The demand for these machines is so great that the company's factory is taxed to its utmost.

In the last few years electricity as a motive power has



THE NEW KAY MOTOR.

come so rapidly to the front that there is scarcely a village or factory where it is not employed extensively for lighting and power purposes. The Kay Electrical Mfg. Co. being among the pioneers in this line, have endeavoured to keep pace with the most advanced improvements and there is hardly a village, city or town from Quebec to Vancouver where there is not more or less of their machinery in operation. In the city of Toronto there are more than three hundred of their machines in use; in Hamilton nine-tenths of the electric power is used through Kay motors. Guelph, Brantford, St. Catharines and Montreal are all extensive users of these machines.

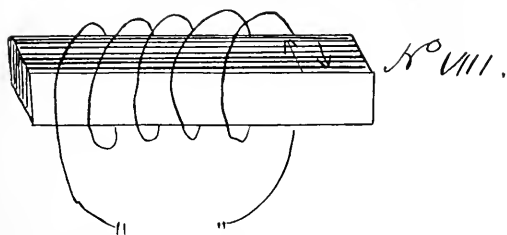
TRANSFORMERS.

By G. W. F.

(Concluded from September Number.)

A COMPARISON of tests made on a number of transformers shows that between the best and the worst there was the difference of about 100 watts per hour in the amount of energy consumed in the above friction—which is called hysteresis. Reducing this to a question of coal consumed, the better transformer consumed on no load more than one ton less than the other. This meant a saving of about \$3.50 per year per transformer, by using the better and more expensive one. This saving capitalized shows that the better transformer was worth at least \$100 more than the other in point of hysteresis saving alone, not considering losses to be investigated later.

A second source of wasted energy is the generation, within the core itself, of Eddy currents which heat up the iron, and so consume power. It will be evident from an inspection of the diagram 6 that the passage of a current through the primary wire P will set up currents, not only in the secondary wire S, but also in the bar A, which is actually a conductor placed in a varying field. These currents will circulate through the bar in directions at right angles to its length, and any means of checking them or reducing them will be an advantage as tending to reduce the losses. A current is stopped by breaking a circuit, and this method is employed in the construction of transformer cores, which are built up of thin sheets of iron placed side by side with some form of insulation between them. Thus, instead of the bar being solid, and so constituting a metallic circuit for Eddy currents, it may be represented by the accompanying diagram No. 8, which shows it made



of sheets separated by other sheets of insulation. The direction of the Eddy currents would be across the length, as indicated by the arrows; but they are evidently checked by the insulation, and so cannot flow in such great strength. The insulation does not interfere with the flow of the line of magnetic force, whose direction is along the bar. It is impossible to quite check or do away with Eddy currents altogether, because just as long as iron is subjected to a varying field, it must necessarily have currents set up in it. We can only minimize the evil by efficient design and construction. Lest it might be thought that these losses—from hysteresis and Eddy currents—are too insignificant to really take any account of, it may be here stated that results of a series of most carefully conducted tests, by persons whose competence was quite beyond question, showed that with transformers of superior make, the losses in very small sizes were sufficient to form about 10 per cent. of the capacity of the transformer, and in the larger sizes between 7 and 8 per cent. What the percentage would be in transformers of inferior make is impossible to estimate for all cases, but a test made on several different transformers by Prof. Jackson showed that, taking two for comparison, a central station using 100 transformers of the size considered would find a difference of \$1,200 in operating expenses between the two makes—that is, the better type would cost less to operate than the other by \$1,200 per year. Transformers are just like everything else—there are good ones and poor ones. A good transformer is the only one that a central station can afford to buy, and a good transformer costs money to build and is therefore expensive.

A third source of waste is the "magnetizing current," and this again can be minimized by careful design and good construction, but not entirely stopped.

This magnetizing current can be understood thus: P is a primary wire from the generator G. S is the secondary, and both are wound round a bar A. It is generally thought that if the secondary circuit is open—that is, when there are no lamps being lighted—that no current will be flowing in the primary circuit P. This is an error. There is a current flowing in P just as long as the generator is operating, whether the secondary is open or closed. The current, it is true, will be but small in the former case, and will increase as the load on the secondary becomes greater; but

it is evident that no matter whether that secondary is open or not, the primary circuit is always connected right across the 1,000-volt mains, and must therefore carry some current. The reason it is so small at open secondary is because a counter electromotive force is set up in the primary by the alternating magnetism which it is itself the cause of in the core. This counter electromotive force is almost equal to the impressed E. M. F., and only the difference

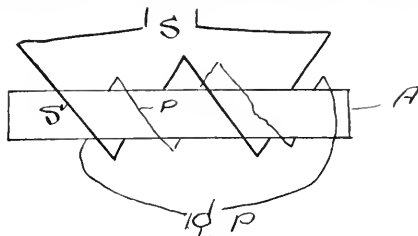


DIAGRAM IX.

between is available for setting up the flow of the small magnetizing current. Whenever the circuit through the secondary is closed, through a lamp or lamps, an E.M.F. will be set up in the secondary, which will indirectly assist the E.M.F. impressed on the primary. In this case the difference between the impressed and the counter electromotive forces acting to force a current through the primary will be greater than at open secondary, and will set up a primary current which will increase as the secondary resistance becomes less by throwing in more lamps. But it must be clearly borne in mind that a current is flowing in the primary whether the secondary is open or not; and further that the amount of this magnetizing current depends on the construction of the transformer, being capable of reduction to a very small amount, or of being made to assume very uneconomical proportions. Two high-class transformers on the market to-day are guaranteed to have the following magnetizing currents: A has '125 of an ampere; B has '0656 of an ampere in transformers of 6,000 watt capacities. Just as long as the generator is operating, A will consume '125 of an ampere, and B '0656 of an ampere, whether there are lamps burning or not. This is sometimes incorrectly called the leakage current. Take an installation of 1,000 lights, using ten of this size transformers. The magnetizing current of the lot will be, with A type 14 amperes, and with B type '656 of an ampere. Reducing this to a matter of watts or horse power: A type will cause a necessary waste of one and seven-tenths of a horse power every hour the generator runs, while B will cause a necessary waste of only nine-tenths (0.10) of a horse power. Assuming that the plant operates for an average of eight hours for 305 nights during the year, and taking coal at \$3.00 per short ton, and allowing 4 lbs. per h.p.h., the calculation is easy that the waste in magnetizing current only using A type transformers amounts to \$30 worth of coal per year, and with B type to \$15.75. This cost, being a constant yearly expenditure, should be capitalized, and at say 5% interest it shows that B type transformers of the above total capacity are worth \$300 more than A type, or \$30 each; and consequently that to use A type instead of B type is a very marked extravagance, unless they can be bought for \$30 less. It cannot be too strongly emphasized, that it is by careful attention to, and consideration of such details that central stations must look to their profits. There have been numerous instances where central stations have turned a yearly deficit into a satisfactory profit by scrapping all their old transformers—with their wasteful magnetizing currents, and heavy hysteresis and Eddy losses—and using instead transformers of the most modern type. In the former case the generator current was lost in the transformer primaries; in the latter it was saved and available for sale. In the calculation made above, two really high class transformers were compared. What will be the results if transformers using half an ampere are taken as the basis? And yet it may easily be verified that plenty of those now hanging on poles in provincial towns take all of that. From the above considerations it will be plain that the efficiency of a transformer is a matter to be seriously taken into account, and that to buy such apparatus on the basis of lowest cost is a most imprudent policy. The facts that such apparatus cannot be watched during operation should make purchasers all the more careful in selecting it.

A point of considerable importance, although not entailing any loss on the central station, is that of the pressure regulation. A transformer, having no means of automatically raising its voltage

as the load becomes greater, necessarily allows a "drop" between no load and full load. A generator has some provision made, either by compounding its field or by hand regulation of the exciting current, for increasing its initial pressure as the current gets larger so that at all amperages the final pressure at the lamps will be constant. A transformer, however, cannot be compounded; nor is it convenient to have a man up the pole to work a rheostat periodically, so that the pressure at its primary terminals is all that is available for causing the flow of current from no load to full load. It is plain, therefore, that at full load the pressure on the lamps will be somewhat lower than at light load, and the difference between these two pressures depends—as indeed does all the data—on construction and design. In the above transformers A has a regulation of 2½ per cent., B, of 1¼. This means that at no load, on one lamp, the pressure will be 2½ volts higher than it will at full load or 100 lamps, with A, and 1¼ volts higher with one lamp than with 100 lamps with B. Thus B will subject its lamps to ¼ of a volt less variation than A, and as the life of lamps decreases about 15 per cent. with every 1% of excessive voltage, it requires no great ability to see that for the consumers' interests B is the better transformer. All the foregoing considerations shew conclusively that transformers are in their way just as important as generators; that they are just as susceptible of careful and educated design and construction as any other apparatus; that to build a thoroughly good transformer requires very superior material and equally superior workmanship; that consequently a good transformer necessarily costs money, and a cheap one bears prima facie evidence of inferiority; that a cheap transformer is the most expensive piece of apparatus that can be bought; and a high priced one the truest economy and the best investment. It is to be hoped also that, in the near future, central station men will come to understand that the more sharply and intelligently that they study their plants and business, and the more they try to keep abreast of the times the better for themselves.

IMPROVED THERMO-ELECTRIC BATTERY.

By JAMES ASHER

THE problem of how to transform heat economically into electricity is one of the most important that can be laid before the inventor. The electrical efficiency of the best thermo-electric battery is probably about one-twentieth only of that of a dynamo driven by a steam engine whose boiler uses an equal quantity of fuel.

We shall now consider where the great waste of heat occurs in the thermo-electric battery. In the first place there is an enormous waste of heat from the chimney. The quantity of heat which escapes from the chimney of a thermo-electric battery is perhaps about equal to that which escapes from the chimney of a stove consuming an equal quantity of fuel in an equal time. Nearly one-fourth of the total heat is radiated from a stove, and three-fourths passes up the chimney and does no useful work except the production of a draught of air for supplying the furnace.

The writer has invented several methods of securing better economy in these thermo-electric batteries which have chimneys and which use no water to cool the ends of the elements.

First Method.—All the air which feeds the furnace is caused to pass within a casing, along and in contact with the ends of the elements which need to be cooled, and then it enters the furnace at an elevated temperature. Thus the heat that would have otherwise been wasted is returned to the furnace, and part of the waste is thereby avoided. In fact, in this method I apply the regenerative principle to the thermo-electric battery. This method will not enable us to save all the heat which otherwise would have been wasted by radiation and convection from the exposed ends of the elements of the battery, because the products of combustion will leave the chimney at a higher temperature than they would otherwise.

Second Method.—An artificial draft is employed in the furnace. It is well known that an artificial draught can be maintained much more economically than can a natural draught in the furnaces of steam boilers. When we use a natural draught a high temperature in the escaping gases is necessary, otherwise the draught would be very feeble. But when we use a blower to force air into the furnace the products of combustion can be made to leave the chimney if required at a temperature but little higher than that of the atmosphere. Hence, the heat from the products of combustion may be used to elevate the temperature of the inner junctions of a thermo-electric battery, row after row, each row

receiving heat from the gases at a lower temperature than the preceding row. The gases part with nearly all their heat before entering the chimney. The first row in this method would naturally receive heat at the inner junctions, but this temperature would be too high for the metals to endure without either fusion or rapid oxidation. In order to overcome this difficulty the writer proposes to force air into the thermo-electric battery beyond the furnace, and so as to mingle with the products of combustion of very high temperature which proceed from the furnace. By this plan we shall have a large volume of mixed gases, at a temperature which will not be too high for the inner junctions of the battery to endure. A great many elements will be needed to absorb the heat from the large volume of mixed gases. The temperature of the last set of elements at their outer ends should preferably not greatly exceed the temperature of the atmosphere.

Third Method.—It is said that the range of temperature in thermo batteries is only about ninety degrees. There is no advantage in maintaining the heated ends at a temperature of more than ninety degrees higher than their cooler ends. This being the case, I propose to utilize the outer ends of the first set of elements as a source of heat for the inner or hotter ends of the second set of elements, the ends of which are nearly in contact therewith, then the outer ends of the second set as a source of heat for the inner or hotter ends of another or third set, and so on until the inner ends of the last set have a temperature of about ninety degrees above that of the atmosphere. Thus I might have about ten sets of elements, the outer end of each set serving as a source of heat for the next set. A portion of the heat which enters each set of elements is transformed into electricity, and therefore, as heat, it disappears.

It is probable that in a thermo-electric battery, constructed according to my plans, the second law of thermodynamics would approximately hold. Supposing that we maintain the inner junctions of the inner set of elements at a temperature of 960° Fahrenheit, and the ends of the last set at a temperature of 150°, then if the second law of thermodynamics holds good here we should have a theoretical efficiency of

$$\frac{(960 + 460) - (150 + 460)}{960 + 460}$$

which is equal to fifty-seven per cent. This is a much greater efficiency than any which has ever been obtained from any steam or gas engine. It should be stated, however, that a deduction should be made for the power required to operate the blower when we use one.

Here, then, are several methods proposed for economizing heat in the thermo-electric battery. All these methods may be combined, then we shall obtain the highest efficiency.

SPARKS.

The failure is announced of the Holmes Electric Co., of Montreal. The assets of the company were recently sold by auction.

It is reported that the first building in Canada to be lighted with acetylene gas will be the new Presbyterian church, Palmerston, Ont.

An employee of the Royal Electric Co., named Sabouth was killed in the Company's factory recently by coming in contact with a large belt.

Following the example of the ladies of London, the members of the King's Daughters Society, Cornwall, acted as conductors on the electric cars on September 16th, with the object of raising funds for the general hospital in that town.

Messrs. R. J. McGowan, Secretary Fire Dept., Toronto, and Z. Benoit, Chief of the Montreal Fire Department, were among the promoters of the National Association of Police and Fire Telegraph Superintendents organized in Brooklyn, N. Y., on September 15th.

Messrs. Fregeau & Lecroix have recently purchased the electric light plant at Three Rivers formerly owned by the corporation. The purchasers propose to obtain power from the falls at Price's Mills on the Batiscan river, 14 miles distant from the city. It is said to be their intention to also supply light to the neighboring villages.

When 350 watts make one horse-power, when copper wire sells for five cents a ton, when six inches make one foot, when two feet make one yard, when one watt equals a kilowatt—then 53 cents will make one dollar, and the people of the United States will stand as the largest aggregation of dishonest repudiators in the history of the world.—New York Electrical Review.

SPARKS.

Since the first of August the Montreal Street Railway Company have refused to accept payment of fares in American silver.

There was a collision on the Hamilton Radial Railway Co.'s line on Sept. 10th. Only two persons were injured, and these but slightly.

The Hamilton Street Railway Co. have notified their employees that a reduction of ten per cent. in salaries will be made commencing October 1st.

The Port Arthur Pulp Timber Co. is being incorporated to manufacture timber and to construct electric light and power works. The capital stock is \$200,000.

Mr. John Patterson states that construction work will be commenced immediately on the plant of the Cataract Power Co., who propose to convey power from DeCew Falls to Hamilton.

The Armington & Sims' Engine Co., of Providence, Rhode Island, which suspended on the first of the month, had a contract to make a 600 horse-power engine for the London Street Railway Company.

The Telephone Company of St. Francois, Riviere du Sud, will seek for an amendment to its charter at the next session of the Provincial Legislature to enable it to prolong its line as far as Montmagny.

Negotiations are in progress between Toronto capitalists and the company who operate the horse car system at Niagara Falls, looking to the transfer of the line and its transformation into an electric road.

The management of the Toronto Technical School have added \$100 to the salary of Mr. James Milne, Lecturer in Electricity, and have given him the supervision of the drafting room, mechanics, electricity, steam and the steam engine.

Application will shortly be made to Parliament for the incorporation of the Moto-Cycle Co., of Canada, Ltd., to manufacture and sell horseless vehicles. The headquarters of the company are to be at Montreal. The proposed capital is \$150,000 in shares of \$10.00 each.

At the annual meeting of the standard Light & Power Co., held in Montreal recently, the former Board of Directors was re-elected and the following officers appointed for the ensuing year: R. Wilson Smith, president; W. McLea Walbank, vice-president and managing director; E. Craig, secretary-treasurer.

The building and plant of the Palmerston Electric Light Co., was totally destroyed by fire last month, together with 100 cords of wood belonging to the company. The loss is a heavy one, the insurance being only \$1,600. It is said to be the intention of the company to rebuild and instal a new plant immediately.

In order to get better service to points between Arnprior and Pembroke, the Bell Telephone Co. has constructed a new copper wire line from Ottawa to Arnprior. The Company have also a direct line from Ottawa to Brockville via Almonte and Carleton Place, and a new line is under construction from Ottawa to Morrisburg, via Metcalf and Winchester.

The courts of Montreal will decide in a day or two whether or not the Standard Light & Power Co. and the Bell Telephone Co. have power to open up the streets of the city and lay underground mains without the consent of the City Council, by virtue of the authority conferred upon them by the Quebec Legislature. Each company has commenced the construction of underground mains, but work has been stopped by the city authorities, pending a legal decision on the above point.

A bill is now under consideration in the Dominion Parliament for the incorporation of the Mather Bridge and Power Company. The object of the company is to bridge the Niagara river at Port Erie and to generate electrical power by means of an immense paddle wheel attached to the centre of the bridge. The bill is being opposed on the grounds that the wheel would be an obstruction to navigation, and that the country should receive a revenue from the utilization of the water power.

The streets of the town of Newmarket have been in darkness since last April, at which time the electric light service was discontinued, on the ground of unprofitableness. Ten thousand dollars have recently been invested by the municipality in a new plant, from which are lighting for the streets and incandescent lighting for commercial and private use will be furnished. The new system is being rapidly put in working order, and is expected to go into operation within a week from date.

The International Trading Co. will submit to the City Council

of Kaslo, B. C., a proposition to install an efficient lighting system, arc and incandescent, on condition that the city will contract at the price of \$100 per month for twelve arc lights, for ten years, and exempt the property of the company from taxation. The company guarantee also to furnish light to private consumers at a reasonable figure, and to sell their plant to the city at a figure to be agreed upon at the expiration of the term of their contract.

The town of Peterboro' recently invited tenders for public lighting. No tenders, were however, received. A letter was read from the Peterboro' Light & Power Co., stating that they refrained from submitting a tender on the ground that the contract was too stringent. They objected specially to the clauses stipulating that the poles be painted and that a penalty of 75 cts. per lamp be imposed should the candle power be found to be at any time less than 2,000. The Council are now considering the question of purchasing a plant and operating it as a municipal enterprise.

Strained relations have existed for some time past between the City Council of Winnipeg, and the Electric Street Railway Company of that city. The Council contend that the company have forfeited their franchise by ignoring the terms of their charter as to character of service and condition of maintenance of the road. Mr. Wm. McKenzie, the president of the road, has just visited Winnipeg with the purpose of arriving at a settlement of the difficulty. He has offered to sell the road to the city, as he claims that it has been a source of trouble to the present owners ever since it was put in operation.

The formal opening of the Lachine Rapids Hydraulic and Power Company's works for the utilization and transmission to Montreal of the power of the Lachine Rapids, took place last month, and was attended by a number of prominent citizens. Mr. Burland, President of the company, reviewed the history of the enterprise, and stated that up to the present about \$800,000 had been paid into the company, proof sufficient of confidence on the part of the directors and shareholders in the success of the scheme. Much credit was deservedly bestowed upon Messrs. W. McLea Walbank and E. T. Pringle, who were the original promoters and subsequently the engineers of the work.

The Chambly Water Power Co. have let the contract to Mr. Peter Lyall, of Montreal, for the construction of a dam across the Richelieu river at Chambly for generating electric power. A contract has also been given to the Stillwell-Bierce Co., of Dayton, Ohio, for the required machinery, while tenders have also been invited for sub-contracts amounting to upwards of half a million dollars. It is proposed to transmit electric power from Chambly to Montreal, a distance of 15 miles. It is expected that about 20,000 horse power can be generated. It is understood that the Royal Electric Co., of Montreal, who are shareholders in the Chambly Power Co., have contracted for a considerable portion of the available power.

In reply to Mayor Fleming, who called in question the impartiality of the tests of the electric light supplied in Toronto, Mr. Higman, Chief of the Inspection Department at Ottawa, declares his report to be an exact record of the conditions as he found them. He states further that no arrangement was made with either party as to the time when the test should be made, nor had either party any opportunity of "padding" the report or exerting any influence that would tend to bias the report for or against either party. Mr. Higman also points to the fact that are lighting dynamos being constant current machines, it would be exceedingly difficult and inconvenient for the company to vary the output to any appreciable extent.

Some experiments on the effect of heat on insulating materials made by Mr. C. E. Skinner, are summarized in the following conclusions: 1. The insulation resistance of all ordinary fibrous insulating materials, such as paper, cloth, etc., decreases upon being heated up, and then increases again when the moisture is expelled. 2. Continued heating of 31 hours at 120 degrees centigrade does not lower the insulation resistance of paper. 3. The insulation resistance of completed apparatus shows the same characteristics as the insulation resistance of materials taken separately. 4. A low insulation resistance is not necessarily an indication of poor insulation, but probably an indication of the conditions of the apparatus in regard to moisture. 5. A high electromotive force should not be applied to apparatus when the insulation resistance is low. 6. Material which is badly deteriorated mechanically by heat may still have a high insulation resistance but very poor insulating qualities.

SPARKS.

The City Council of St. Thomas have decided to grant a three years lighting contract to the gas company.

An effort is being made to induce the Council of North Bay to have the streets of that town lighted by electricity.

A bill has been introduced in the Dominion Parliament to incorporate the Columbia Telephone & Telegraph Co.

The Gravenhurst Electric Light & Power Co. have succeeded to the business of the Gravenhurst Electric Light Co.

The St. Johns, Que., Electric Light Co., are negotiating for the necessary supply of power to operate their system successfully.

Wm. Simpson, an electrician with the Cortland Automatic Fire Alarm Co., won the first prize in the recent bicycle road race at Toronto.

The Consolidated Railway & Light Co., Victoria, B. C., will install an additional dynamo, weighing 8,000 lbs., purchased in England.

The Peoples' Heat & Light Co., composed of Boston capitalists, is reported to have purchased the franchise and works of the Halifax Gas Light Co.

The Nova Scotia Telephone Co. have just completed their new line between Glasgow, Pictou & Truro, in connection with their long distance line to Halifax.

Mr. J. W. Taylor, late manager of the Ottawa Porcelain & Carbon Co., is said to have purchased a valuable Feldspar mine suitable for the manufacture of porcelain ware and insulating material.

It is reported that an electric railway is to be immediately constructed from Liverpool, N. S., to the pulp mill at Milton, N. S., to carry the product of the mill to the seaport, and also to carry passengers.

The Sussex, N. B., Water & Electric Light Co. has recently been organized, and is about to erect a station 28 x 50 ft. in size. The company expect to have their plant in operation before the close of the year.

The Ottawa Electric Railway Co. are equipping their cars with fenders. It is proposed to place a fender at one end of the car only, and to construct loops so that the car may be turned around at the end of the trip.

As a result of a recent visit of the president and directors of the St. John Railway Co., it was decided to remove the electric plant to the Company's new building on Smythe street, and to install additional machinery.

The Montreal Street Railway Co. have just completed the construction of an immense new chimney, the diameter of which is 54 feet at the base, and the height 225 feet. Two million bricks were used in its construction.

A bill is before Parliament to authorize the formation of the Canadian Electric Light & Power Co., with authority to build an electric railway from Cobourg, via Port Hope, Toronto and Hamilton, to the Suspension Bridge.

Li Hung Chang, the distinguished Chinaman who recently visited Canada, took his first ride in an electric car on the Niagara Falls Park & River Electric Railway, having previously refused to embark on the American Gorge road.

The Quebec Legislature will be asked at its next session to incorporate the St. Hyacinthe City & Granby Railway Co. to construct a railway to be operated by steam, electricity or other motive power, from Brigham, Brome county, to St. Hyacinthe. Capital \$100,000.

On the route of the extension of the Montreal Park and Island Railway to Lachine, there has been discovered a piece of swamp which will entail a great deal of expense in the way of filling up. About 2000 loads of slabs have already been used as filling, and the end is not yet.

The Richelieu Telephone Co.'s property has recently been purchased by the Pare & Pare Telephone Co. The company's lines run from St. Ramie to St. Guillaume, Que., connecting with other lines, forming a system of 263 miles in length, connecting 47 towns and villages.

The corporation of St. Johns, Que., have recently entered into a new contract with the electric light company. In future only a few of the principal places in the town will be lighted with arc lights, other parts being lighted by 25 c. p. incandescent lights. The total cost to the corporation will be \$1,200 per year.

Mr. W. H. Meldrum is at the head of a new company which has lately been formed in Peterboro' for the purpose of supplying electric power. An electric plant, including multiphase generat-

ors and motors, costing in the neighborhood of \$25,000, is being installed for the company, under the direction of Mr. J. M. Campbell, electrical engineer of Gananoque.

The following are the officers elect of the Halifax Tramway Co.: President, Henry M. Whitney; Vice-Presidents, John V. Payzant and Hon. D. McKeen; Secretary, B. F. Pearson; Directors, John V. Payzant, Adam Burns and Thomas Fysche. The company have taken over the road from Mr. Brown, the contractor, and it is in successful operation.

The Hull and Aylmer Electric Railway Co. are endeavoring to obtain from the Dominion Parliament the necessary legislation to allow them to change the name of the company to the "Hull and Aylmer Railway Co.," and to cross the Suspension bridge and land passengers in Ottawa. Their application is being strongly opposed by the Ottawa Electric Railway Co.

Notice is given that application will be made at the next session of the Dominion Parliament for the incorporation of a company to construct and operate a railway easterly from Vancouver through the North-West Territory and Manitoba and the province of Ontario to the Great Lakes, and to construct and operate telegraph and telephone lines along the said railway.

A charter will be applied for on behalf of the St. Jerome Power & Electric Light Co., Ltd. The object of the company is to acquire the electric plant now in operation at St. Jerome, Que., and the water power and mill privileges by which the same is operated. The proposed capital stock is \$50,000; the chief place of business to be at St. Jerome, and the head office at Montreal.

A company has been formed at Quebec to take over the franchise given by the City Council to Mr. Beemer for the construction of an electric street railway. About a quarter of a million dollars has already been subscribed, and the construction of the road is to be commenced immediately. The power for the operation of the road will be supplied by the Montmorency Electric Light & Power Co.

It is reported that owing to the unwillingness of the Dundas town Council to grant the assistance asked for, the Hamilton & Dundas Railway Co. have abandoned, for the present at least, their intention of reconstructing the road and adopting electricity as the motive power. Instead of so doing it is said to be the intention to purchase a new dummy engine and new cars, and to lay new track between Dundas and the limits of the city of Hamilton.

A report on the route of the proposed Huron & Ontario electric railway has been presented to the president and directors of the company by the engineer, Mr. A. Brunel. It is proposed to utilize a number of water powers in the county of Grey for power purposes. The entire length of the road will be 285 miles, and it is stated that the road will open up a new section of country with a population of 140,000, and secure trade which is now carried on by means of horses.

It is reported that the business of the Niagara Falls Park & River Railway Co., for the past season has been disappointing, and that steps are to be taken to reduce the cost of operation. In this connection it is also reported that Mr. Ross Mackenzie, the manager of the road, has tendered his resignation and has been succeeded by Mr. Phillips, late chief engineer, and that negotiations are in progress between the directors of this road and the Niagara Gorge road, looking to the amalgamation of the two systems.

The Lachine Rapids Hydraulic & Power Co. have commenced the erection of a receiving station at the corner of Seminary and McCord streets, from which wires will be strung on steel poles to the generating works at Lachine. On some streets, however, underground conduits will be laid, provided the dispute between the company and the city of Montreal regarding the laying of these conduits shall result favorably to the company. A contract for 507,000 lineal feet of concrete-lined iron conduit has been given to the National Conduit Co., of New York, at the price of \$150,000.

The City Council of Victoria, B. C., recently passed a by-law imposing a number of restrictions upon the operation of the street car system of the Consolidated Railway Co., of that city. The railway company have obtained from the courts an order that the validity of this by-law shall be argued and legally decided. The railway company claim that the by-law is illegal, inasmuch that it seeks to impose conditions and restrictions which are at variance with the agreement of 1894 between the city and the Victoria Electric Railway & Lighting Company, to whose charter the Consolidated Railway Co. have succeeded.

PRESERVATION OF WOODEN POSTS.

The conduction of the electric current for various purposes necessitates the use of an immense number of wooden posts as supports for the conducting wires and cables, and the preservation of these posts, which are set in the ground, is a question which has caused electric and other engineers a large amount of thought.

According to "La Nature" great interests are involved, for it is estimated that in Europe, alone, there are about 20,000,000 posts in use for carrying electric wires. The wood, where it is set in the ground, "betwixt wind and water," is very soon destroyed, and a number of posts have to be replaced each year. It is estimated that in Europe, alone, the maintenance of the posts costs nearly \$4,000,000 per year.

Attempts have been made to prolong the life of the post by the injection of metallic salts, as sulphate of copper, or iron, or creosoting, and a certain measure of success has been obtained; but in time rains dissolve and carry away these substances. It is now proposed to protect the weak point of a post by a stoneware cover. This has been tried and has given good results.

Numerous observations have shown that a post is attacked for a length of from ten to twelve inches from the surface of the ground, which is the depth to which rains usually penetrate. This distance is covered with two half cylinders of salt-glazed stoneware joined together, and the space between the stoneware and the post is filled with a damp-resisting cement, such as Portland cement with sand or gravel. A ring is fixed onto the post just above the level of the stoneware coat, and the top is made up of cement laid at an angle so that the rain will run off.

Very careful experiments go to show that this method of preserving a post will increase its life by more than five times, and the cost would be very slight in comparison to the benefits obtained.

LEGAL.

Re Brantford Electric and Power Co. and Draper.—Judgment on appeal by the company from order of Falconbridge, J., referring an award back to the arbitrator. The company were the assignees of the lessor, and Draper was assignee of the lessees, mentioned in the lease of water power. The lessor had an option under the terms of the lease to refuse to renew the term, in which case he was to pay for the "building and erections" on the land, at a price to be ascertained by the arbitrator. The award in question made upon the lessor's election not to renew did not award to the lessee the value of certain fixed and moveable machinery. The order of Falconbridge, J., directed that the value of the machinery should be included. The court dismissed the appeal with costs.

The suit of the Royal Electric Co., of Montreal, against the town of Maissoneuve, and the Edison General Electric Co., intervening, was argued recently before Mr. Justice Charland in the Superior Court at Montreal. The Montreal Gazette prints the following particulars and decision: "The plaintiff alleged that on the 16th October, 1891, by deed before notary, it was agreed between the parties that the plaintiff should furnish the town of Maissoneuve with a complete system for the lighting of the town by electricity, the sum stipulated being \$9,300; that the plaintiff immediately manufactured the necessary apparatus and prosecuted the work with diligence until stopped by an injunction and other legal proceedings. The plaintiff claimed the sum of 4,375.50, with interest, for work done and material furnished. The defendant called in the Edison General Electric Company in warranty, and the latter company took up the suit in behalf of defendant. The Court held that the plaintiff had proved its allegations, and that the intervening party had not proved its pleas, and judgment was given in favor of the plaintiff for the amount claimed, \$4,861.17."

PERSONAL.

Mr. A. E. Edkins, of the Boiler Insurance and Inspection Co.'s staff, sailed a few days ago per steamer *Lucania* for England.

Mr. H. M. Whitney, formerly president of the West End Street Railway company, of Boston, has been elected president of the Halifax, N. S. Electric Tramway company.

The many friends of Mr. Ross McKenzie, manager of the Niagara Falls Park & River Railway, will be pleased to learn that he is recovering from the severe attack of typhoid fever, which at one time threatened to prove fatal.

Mr. W. E. Davis, formerly electrician of the Toronto Railway company, and more recently electrical engineer and purchasing agent of the Detroit Railway, has been appointed manager of the Bearinger electric road, operating between Saginaw and Bay City, Mich.

It is announced on the authority of Professor McCallum, who is at present in Europe in connection with arrangements for the meeting of the British Association next year, that Lord Kelvin, the celebrated electrician, will be among the scientists who will attend this meeting.

Mr. C. F. Medbury has resigned his position with Messrs. Ahearn & Soper, of Ottawa, and has accepted a position with the Western Electric Company, of Chicago, with headquarters in New York city. The removal of Mr. Medbury will be deeply regretted in electrical circles in Canada. He was acknowledged to be one of the brightest, most energetic and gentlemanly of the representatives of the manufacturing companies in the Dominion, and may be expected to give a good account of himself in whatever capacity he may be placed.

TRADE NOTES.

The Beaverton Electric Light Co. are adding a 250 light Edison dynamo to their present plant.

The Consolidated Railway Co., of Vancouver, have installed a 150 kilowatt monocyclic generator.

P. McIntosh & Sons, Toronto, have purchased a 300 light plant from the Canadian General Electric Co.

The Canadian General Electric Co. have sold a 150 kilowatt monocyclic generator to the Hull Electric Co.

The O'Keefe Brewing Co., of Toronto, are installing a 300 light direct-connected unit. The Canadian General Electric Co. have the contract.

The New Glasgow Electric Light & Power Co. are installing a 75 kilowatt alternator of the Canadian General Electric Company's monocyclic type.

The firm of Ness, McLaren & Bate, electrical supplies, Montreal, has been dissolved. Mr. Norman W. McLaren will continue the business under the former name.

The Royal Electric Co. are installing in the asylum for insane at Mimico two direct current generators with a capacity of 500 lamps, to supplement the plant which was put in there some years ago.

Messrs. John Starr, Son & Co., of Halifax, have recently issued a very complete catalogue of 70 pages, and of convenient size, containing illustrations and prices of the various kinds of electrical apparatus which they handle.

The Weekes-Eldred Co., sole manufacturers for Canada of the Improved Jones Under-Feed Mechanical Stoker, have opened an office at No. 512 Board of Trade Building, Toronto, preparatory to introducing the invention throughout the Dominion.

The Colliery Engineer Co., proprietors of the International Correspondence Schools, at Scranton, Pa., were partially burned out on the morning of the 30th of August. They advise us that fortunately their printing plant was in another building, and they had reserves of all instruction and question papers, drawing plates and other supplies and stationery used in the schools in still another building, so that their business will not be seriously interfered with. They have secured new and more commodious offices and are prepared to enroll and instruct students as usual.

The Corporation of the town of Sudbury have closed a contract with the Royal Electric Co. for the installation of one of their 75 kilowatt "S. K. C." two phase alternating current generators; from which they will operate 15 alternating current arc lamps for street lighting, about 1,000 incandescent lamps, and a number of motors. We are advised that this is the first alternating current plant in Ontario, other than experimental, and demonstrates the flexibility of the alternating two phase system. They can serve a night load as well as a day load, from the same dynamo, and only use one circuit, making it possible to run a lighting and power system with only one circuit and one machine.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRICITY ON A STEAM ROAD.

THE latest development in Canadian electric railway work is the equipping of the Aylmer branch of the Canadian Pacific Railway with electric service. This line extends from Hull, a suburb of Ottawa, to Aylmer, where it connects with the Pontiac Pacific Junction Railway extending 60 or 70 miles up the north side of the Ottawa river. The section from Hull to Aylmer has been leased by the Hull Electric Co. for a term of 35 years, the understanding being that besides passenger and mail traffic they are to handle all through and local freight delivered to them by either the Canadian Pacific Railway or the Pontiac Pacific Junction Railway. As they are the only connecting link with the Pontiac

Ont., and operate under a head of 9 feet. Four 60 inch wheels are now installed and space is provided for two more.

The electrical equipment of the power house consists of two M. P. 4-200-425 generators built by the Canadian General Electric Company. For controlling the output of these machines there is a white marble switchboard consisting of two generator panels, two feeder panels and a total output panel, all of the General Electric standard type and supplied by the Canadian Co. Besides these there are three panels containing the "Barbour" water wheel regulator by which the current output of the generators is automatically kept constant by cutting in or out dead resistance



ELECTRIC LOCOMOTIVE—AYLMER BRANCH CANADIAN PACIFIC RAILWAY.

Pacific Junction Road it can readily be understood that the quantity of freight is considerable, amounting usually to 50 or 75 cars per day. This freight is mostly handled at night, leaving the road free during the day for passenger traffic.

At the Aylmer end of the line the company owns 60 acres situated on Deschesne Lake, a sheet of water three miles wide by 27 miles long; an ideal spot for sailing and boating, thus forming a strong attraction for the Ottawa citizens. Indeed the traffic has been far beyond expectations and the train service had to be increased until they are now running 36 regular train each way per day besides special excursion trains.

The power is obtained from Deschesne Rapids, where the lake of the same name empties itself into the Ottawa River at a point midway between the termini of the road.

The wheels are of the "New American" type manufactured by Wm. Kennedy & Sons of Owen Sound,

as the load varies on the line. By this means the speed of the machines is kept constant and the variation in voltage is held within a very close limit.

The car sheds and repair shops are also at Deschesne and are fully equipped with all modern appliances for handling and inspecting the rolling stock which at present consists of five closed cars and five open cars, besides a mail, baggage and express car and a locomotive. All the cars are mounted on double trucks, and are each equipped with two G. E. 1200 motors with K.21 controllers. The closed cars are 42 feet long over all and finished in mahogany throughout, the outside sheeting being also solid mahogany finish, in the natural wood. These cars have extra large vestibules at each end provided with seats for the accommodation of smokers, and divided from the main part of the car by double sliding doors. The open cars have 13 benches with reversible backs and their finish and solidity are excellent. All these cars were built and equipped at the Canadian General Electric Co.'s

Peterboro factories from where they were shipped complete ready for delivery on the track.

The locomotive is of particular interest, being the first of the kind operated in Canada. It weighs something over 20 tons and is provided with double trucks, each axle being equipped with a motor. As all the wheels are driven full traction advantage is obtained from the total weight and a draw bar pull of 10,000 lbs. can therefore be exerted, equivalent to the power of the average 35 or 40 ton steam locomotive. This was also designed and built by the Canadian General Electric Co.

In equipping this road the Hull Electric Co. have evidently constantly kept before them the maxim that the best is the cheapest in the end, and will no doubt reap the advantage by long life in their apparatus and small repair bills.

The president is Mr. Alexander Fraser; vice-president, Mr. W. J. Conroy; secretary-treasurer, Mr. Jas. Gibson; and managing director, Mr. H. B. Spencer.

Besides operating the railway, the company have also exclusive privileges for both private and public lighting in the city of Hull and the town of Aylmer, and for the purpose there is installed at the power house a 150 K. W. monocyclic generator with a standard switchboard panel and equipment.

A NEW DEPARTURE IN STREET RAILWAY PRACTICE.

THE proposition was seriously discussed, in connection with the opening of a new electric railway project in Eastern Ontario, recently, to employ good looking young women as conductors, as a means of popularizing and enhancing the receipts of the road. It remained, however, for Mr. C. E. A. Carr, manager of the London, Ont., Street Railway Co., to make a practical test of the idea.

With the object of raising funds to assist in furnishing the new Y. M. C. A. building, about eighty good looking and fashionable ladies of the city arranged with the street car company to act in the capacity of conductors on a certain day, trusting to their charms to swell the receipts and realize a surplus for the purpose mentioned. On the day preceding the one on which they were to enter upon their duties, the ladies took practice trips over the lines, and made careful mental notes of the manner in which the conductors performed their duties.

It was arranged that the ladies should divide themselves into detachments, each detachment remaining on duty for two hours at a time. Much to everybody's surprise, especially as the morning of the day fixed for the experiment proved to be a wet one, every lady conductor reported for duty at the early hour at which the cars begin running. More than half of the preceding night had been spent in decorating the cars with bunting, and when the rain came, it destroyed the results of all the labor bestowed in this direction. Instead of giving way to discouragement, the ladies soon had the interior of the cars charmingly decorated with cut flowers.

In order that the company might not violate the clause in their agreement with the city which provides that at least two men shall be in charge of each car, the manager writes us that the company's own conductors had charge as on other days, the ladies merely collecting fares with the fare box and issuing transfer tickets. One young woman, however, is credited with having

done all the work in conducting her car during several shifts. She collected fares, stopped and started the car to take on and let off passengers, registered the fares, made change and issued transfers, and also ran ahead of the car at the railway crossings.

The ladies are said to have refused to recognize passes, no matter by whom presented, and certain of the city officials who are accustomed to free transportation were told that they must either put up the amount of their fare in good coin of the realm or get off and walk. Having become unaccustomed to walking, they had recourse to the other alternative.

Among the many amusing incidents of the day, a local paper records the following: "One of the officials of the road saw a very funny thing on the Springbank line just before three o'clock in the afternoon. The conductor on the car in question (which was returning to the city) did not have a chapron or any passengers on board, and the young woman was on the front platform taking instructions from the motorman. Seeing another car coming, and thinking that some of the officials might be aboard the motorman tried to get the young woman to leave the controller, and the switch. This she would not do, and the motorman, bound to be found on duty at all events, put his both arms about the girl and also held the mechanism governing the current. Passengers on the passing car caught a glimpse of the queer sight as the up car passed, the girl smiling saucily, and the motorman looking abashed at having to hold in his arms a bundle of charms in broad daylight."

Manager Carr informs us that notwithstanding the unfavorable weather the venture was on the whole a satisfactory one for the street railway.

BERLIN AND WATERLOO ELECTRIC RAILWAY.

Mr. E. Carl Briethaupt, President and Manager of the Berlin and Waterloo Electric Street Railway, is evidently determined to make this a thoroughly up-to-date road. When electricity was adopted as the motive power, light rails which were previously in use were retained. Last winter, however, proved them to be unsuitable, great difficulty being experienced from snow and ice. The old horse cars were also made to duty, after having been vested. They too proved to be unsuited to the new order of things, and have been replaced by the most modern style of coaches. The necessary quantity of 60 lb. steel rails has now been purchased, to replace those at present in use; new car barns are in process of construction, and the spring of 1897 will see the road in a position to offer its patrons first-class accommodation.

CANADIAN VS. ENGLISH ENTERPRISE.

It has been recently stated on good authority, says London Lightning, that there are at work or under construction in Canada 36 electric street railroads, with a total length of nearly 600 miles. No less than 750 motor cars are in use or building, and the sum invested in the various undertakings is a little over four millions sterling. England in the meantime is just beginning to wake up, rub her eyes, and wonder whether the horse-tram could really be improved upon, and whether 1d. a mile running costs, with speed, cleanliness and comfort, are, on the whole, preferable to 7d. a mile running costs, polluted streets, frowsy buses, the travelling

powers of a gouty tortoise and the horrors of cruelty to animals. "But," says the dear old grandmother of nations, "we might hurt somebody, or frighten a dog; and then, after all, we have got on without these things so far," and she dozes again. The Canadian company which recently purchased control of the Manchester tramway, will shortly show our British friends how to construct and operate an up-to-date road.

The town of Orillia is receiving tenders for the supply of a fire alarm system.

The village of Huntsville is receiving tenders for the installation of an electric lighting system.

FOR SALE

One 50-Light 4 Ampere (Ball) Arc Dynamo, with Station Apparatus and 46 Lamps; also one 25-Light 8 Ampere (Reliance) Dynamo, all in good order.

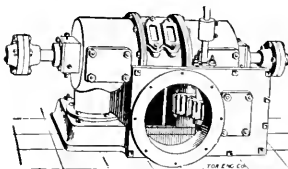
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CANADIAN
ELECTRICAL NEWS
AND
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VOL. VI.

NOVEMBER, 1896

NO. 11.

AN OLD FIRE ENGINE.

THROUGH the courtesy of Mr. James Devlin, Chief Engineer of the Kingston Penitentiary, we are enabled to present to our readers an illustration and some particulars of an old fire engine which has found a resting place in that institution, and which was an object of much interest to the delegates to the last annual convention of the C. A. S. E., on the occasion of their visit to the penitentiary. The engine was made by Mr. Perry of Montreal, brother of Mr. Alfred Perry of that city, and took first prize at an exhibition held in Montreal, the finest workmanship being displayed in its construction.

The engine was purchased by the government of Upper Canada upwards of forty years ago for the sum of \$1,100, and is to-day in all its working parts quite as good as new.

The large number of torpedo boats now being built for the U. S. navy brings forth some features in machinery exceptionally interesting and novel. On some boats of this kind recently launched, the equipment of steam pumps, as well as the main engines, are run without the use of oil in the steam cylinders. While this is not a new idea so far as vertical steam engines are concerned, it has never been the practice to run steam pumps without oil. The pumps are arranged without any oil holes whatever, so that it is impossible to get oil into the steam cylinders. These pumps were given an exhaustive test for several days by the manufacturers and they operated with entire satisfaction, and without using a drop of oil. The doing away with the use of oil in the steam cylinder of a vessel is a matter of considerable importance, as there is no necessity of carrying feed water filters and no anxiety about oil injuring the body. — Scientific Machinist.

The Canadian Customs authorities have lately given a decision to the effect that all electric bells imported into the country are subject to a duty of 25 per cent. ad valorem.

**IMPROVEMENTS BY THE TORONTO
ELECTRIC LIGHT CO.**

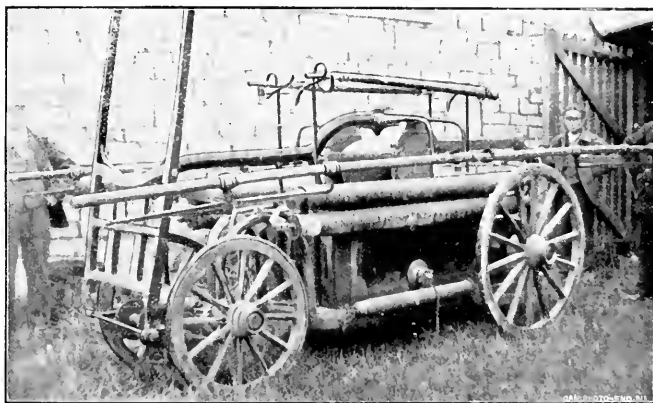
THE Toronto Electric Light Co. have erected a new incandescent and power station, adjoining their other stations on the Esplanade. The new station is constructed entirely of brick and iron, so that there is nothing for fire to feed upon. The work on this station has been considerably delayed owing to the failure of the contractors to furnish the galvanized iron roofing material as promptly as required. Inability to roof in the building has prevented the installation of the machinery.

An immense foundation of concrete has been put in to carry the required steam and electrical plant. A large vertical engine is now being put in position, and it is expected that the entire equipment of machinery for this new station will be in operation before the close of the year.

In the large station adjoining there has just been put in a new condenser operating vertically and driven by a small direct connected verti-

cal engine. This condenser was built under the direction of Mr. J. J. Wright, the manager. It is of much heavier construction than most of those we are accustomed to see, the object being to avoid the many break-downs which have been experienced from the constant operation of lighter machines. Mr. Wright is a believer in the wisdom of putting a sufficiency of cast iron into steam and electrical machinery for use in the electrical business, to give it the strength necessary to withstand the strain of constant operation.

The most economical point of cut off in an engine, says the Boston Journal of Commerce, is not that point that will expand the steam down to the atmospheric pressure, but is a point between three-tenths and one-third cut-off. A variation of a slight amount either side of this point makes but little difference, and we would not call an engine with eight pounds terminal under eight pounds pressure as overloaded.



AN OLD FIRE ENGINE—KINGSTON PENITENTIARY.

THE LACHINE RAPIDS HYDRAULIC & LAND COMPANY'S WORKS.

It is barely a year since we first announced that a company was being formed, whose object it would be to harness the Lachine Rapids to utilize its dormant power for electric purposes.

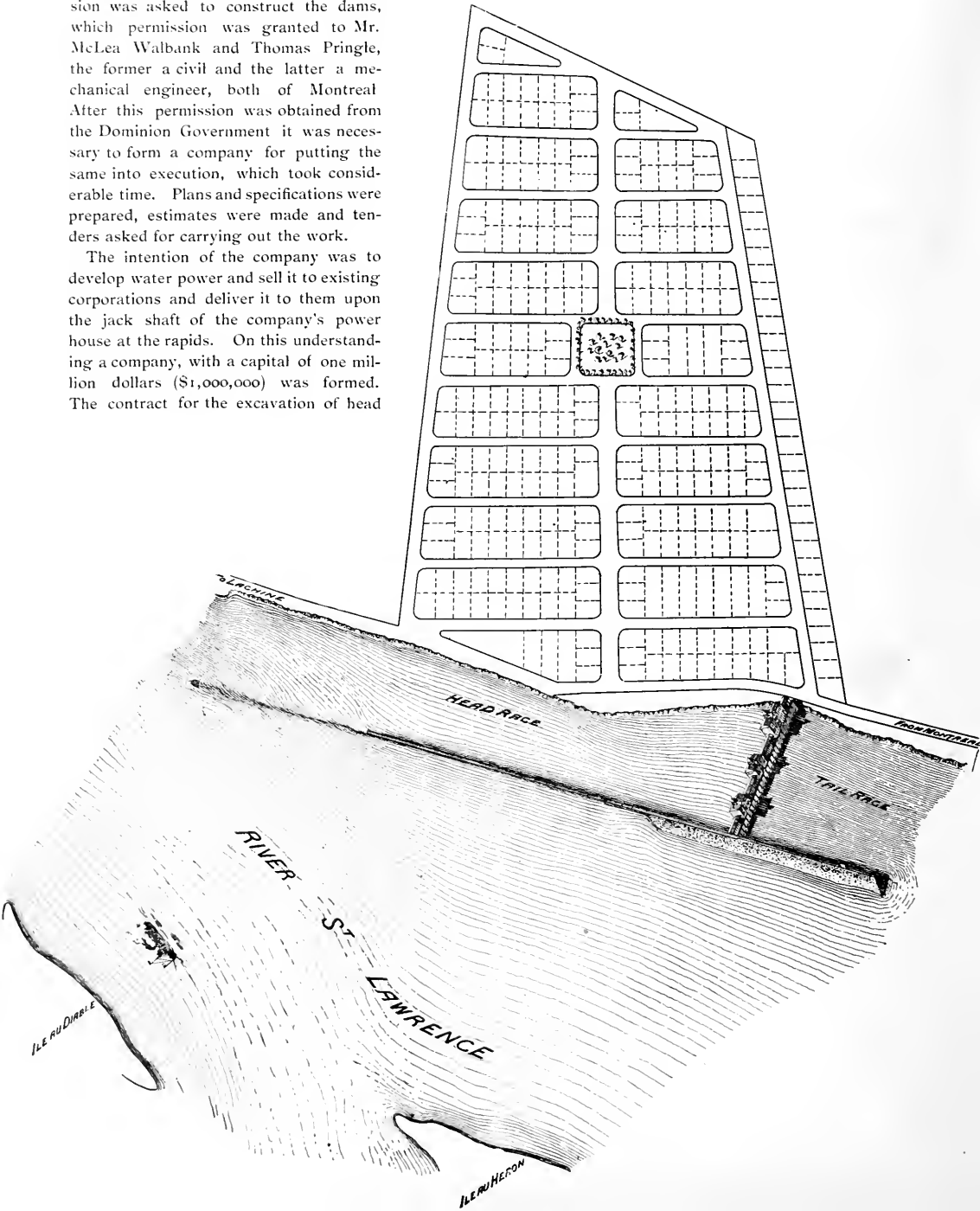
Without a visit to the works in question it is impossible for anyone to conceive an idea of the magnitude of the undertaking and the amount of work already accomplished.

It was only at the end of August, 1895, that permission was asked to construct the dams, which permission was granted to Mr. McLea Walbank and Thomas Pringle, the former a civil and the latter a mechanical engineer, both of Montreal. After this permission was obtained from the Dominion Government it was necessary to form a company for putting the same into execution, which took considerable time. Plans and specifications were prepared, estimates were made and tenders asked for carrying out the work.

The intention of the company was to develop water power and sell it to existing corporations and deliver it to them upon the jack shaft of the company's power house at the rapids. On this understanding a company, with a capital of one million dollars (\$1,000,000) was formed. The contract for the excavation of head

and tail races and the construction of stone and crib dams was awarded to Messrs. Wm. Davis & Sons, of Ottawa, and the work actually got under way late last fall.

The directors immediately set about trying to dispose of their power, and having offered it at what they considered a reasonable figure to several large corporations, who declined to negotiate until the completion of the works in question, perhaps thinking that when completed so large a power would only be in the market for the very wealthy corporations, they made no



offer, doubtless figuring that "Possession is nine points of the law," and that a company without rights or franchises would have small chance of disposing of their power, and they waited for a bargain.

The directors of the Lachine Rapids Hydraulic & Land Company knew the value of their power, they had



MR. G. B. BURLAND, President.

faith in their undertaking, at least the promoters had, and at a meeting of the shareholders, held some time later, it was decided, that if the opinions of the company's engineers could be corroborated by outside experts, the necessary money would be forthcoming to convert the power into electricity, and sell it wholesale and retail directly to the customers themselves. Messrs. Walter Shanley and T. C. Keefer, two of our best known engineers, were consulted, and after hearing the explanations of the company's engineers on the question of frazil or anchor ice, back water, examining the plans and specifications of the works, their report more than



MR. T. PRINGLE, Vice-President and Engineer.

endorsed the statement already given, and it was therefore decided to increase the capital of the company to two million dollars, and to award contracts for electrical machinery.

The next question considered was the ingress into the city, and here the company met with considerable opposition, but having quietly secured the controlling interest in the stock of the Citizens' Light & Power Company, Ltd., whose works are situated at Cote St. Paul, a company having a notarial agreement with the city of Montreal for the erection of poles in all its streets, having contracts for street lighting for long terms of years with the towns of St. Henry, St. Cune-

gonde, Westmount and St. Louis de Mile End, and the lighting of the Montreal Harbor, also various contracts for private lighting, they seized the opportunity of obtaining an extraordinary entrance into the city of Montreal. Existing corporations did not like this step on the part of the Lachine Rapids Hydraulic & Land Company, and as soon as they commenced to avail themselves of their rights to erect poles, no less than two companies entered suit to prevent them doing so. This resulted in the company acquiring the charter of the Standard Light & Power Company, which was granted by the Legislature of the Province of Quebec, and which gives, without the city's consent, the



MR. W. McLEA WALBANK, Managing Director.

authority to lay underground conduits in the streets of the city of Montreal. It was however reserved in the charter for the city to prescribe the manner in which the streets might be opened. But the city treated the requests of the company with contempt, and on the company commencing operations, their men were forcibly restrained and arrested at the request of the Montreal City Council. The result was, that Mr. Walbank, the vice-president and managing director of the Standard Light & Power Company, applied to the superior court for an injunction to restrain the city police from interfering with the men in the carrying out



MR. A. PRINGLE, Secretary and Engineer.

of their work. The injunction was granted and the case argued and won by the company. The city went to appeal, and judgment in appeal was rendered quite recently, unanimously maintaining the company's charter, and declaring the injunction absolute and allowing the work to go on. Therefore the Lachine

Rapids Hydraulic & Land Company with its associated companies have now pole rights and underground rights throughout the whole city.

DESCRIPTION OF THE WORKS.

The plan of the works on a very small scale is shown, which gives the head race and wing dam, guard pier, tail race and main dam with power houses on it, and the land acquired for the future model high class suburb that the company propose to erect.

The proposed head race is one thousand feet wide at the main dam and is about four thousand feet long, and will have an average depth of water of thirteen feet. The bottom of the tail race will be some nine or ten feet lower than the bottom of the head race, and will be some twelve or fifteen hundred feet wide, allowing ample capacity for the carrying away of the water discharged from the wheels. The main dam is constructed of cut stone, about four feet wide and about fifty feet long, set to quarter inch joints and grouted in cement filled in with concrete between the stones. These stone piers rest upon concrete foundations which start at the wheel pit level and finish at the top of the flume bottom. There are two vertical sliding gates in each flume and system of stop logs at the lower end



MR. ALEX. FRASER, Director.

with a steel frame and iron rods secured to the bottom of the flumes, so that the weight of the water will have a tendency to assist in holding the stop logs in position. In front of these is an iron rack especially made to keep off all debris from the wheels. The wheels themselves are "Victor" make and have been tested at Holyoke and given over eighty per cent efficiency. The wheels are vertical and governed by an improved governor which will control the speed within 2% from no load to full load. The wheels will be coupled by bevel core gears to a horizontal shaft, six in series, and at the extremity of the shaft will be a 750 K.W. generator which is being made in Schenectady for the Canadian General Electric Company. The speed of these machines will be 175 revolutions, generating a current of 4400 volts. They will be the most modern three-phase machines and built to be easily moved for repairs.

The increase of temperature after a continuous run of twenty-four hours at rated speed must not exceed forty degrees centigrade above the temperature of the air at five feet distance from the shaft. The inherent regulation of the dynamo shaft shall be set with the drop of potential between 10% at rated load, and the non-inductive load shall not exceed 6%. The dynamos

are to operate regularly and parallel, having common bus bars. And in so operating, each dynamo must carry its portion of the total load. The insulation is to withstand successfully a potential ten times as great as that for which it is designed, and the armature to be tested for twenty thousand volts.

As already stated, the wheels shall be connected six to each machine, there being twelve machines, there



MR. PETER LYALL, Director.

will be in all seventy-two wheels. The power house will consist of a building about one thousand feet long with three centre portions divided off so as to form the dynamo house starting from the shore.

There will be on each line of shaft six wheels and a generator; then a generator and six wheels; then again six wheels and a generator and a generator and six wheels; then six wheels and a generator; then a generator and six wheels. This doubled will complete the electrical lay-out. The building is of steel construction, the dynamo portions being Laprairie pressed brick. The foundations and flooring of the dynamo houses are of concrete and steel beams, and the turbine sheds of steel work with three inch plank covered with corrugated iron.

A traveller, capable of carrying twenty-five tons with



MR. E. K. GREENE, Director.

thirty-nine feet span, will travel the full length of the dynamo house and turbine sheds moving any machinery that may be required and at the same time placed so as to lower or raise the head gates. The switch-boards will be of the latest type. The pole line starting from the power house is constructed of lattice steel poles and calculated to stand a wind pressure of six thousand pounds. It is fitted up with 6x6 cross-arms, made of

British Columbia fir with double petticoated porcelain insulators, and carrying No. 6 wires as far as the Lachine Canal, near the Curran bridge, when it will pass underground until it enters the sub-station located at the intersection of Seminary and McCord streets. The current will from this point be distributed throughout the city in underground conduits, which are being constructed by the Standard Light & Power Company.



MR. W. P. DAVIS, Senior Member of the Firm of Wm. Davis & Sons, Contractors.

The names of the officers of the company and of the engineers and contractors of the works, are as follows:—

G. B. Burland, Montreal, President.
 Thomas Pringle, Montreal, Vice-President.
 W. McLea Walbank, B.A. Sc., Montreal, Managing Director.
 Alexander Pringle, Secretary Pro-tem, Montreal,
 Alexander Fraser, Ottawa, Director.
 E. Kirk Greene, Montreal, Director.
 Hugh Graham, Montreal, Director.
 Peter Lyall, Montreal, Director.

ENGINEERS.

T. Pringle & Son and W. McLea Walbank, Montreal.



MR. W. H. DAVIS, of Wm. Davis & Sons.

CONTRACTORS.

For dams and excavation, William Davis & Sons.
 For iron work, Dominion Bridge Company.
 For wood work, the James Shearer Company, Ltd.
 For water wheels and hydraulic machinery, Stilwell-Bierce & Smith-Vaile Company.
 For electrical machinery, the Canadian General Electric Co.

For wire work, the Dominion Wire Works.

Underground conduits, National Underground Conduit Co., New York.

We are pleased to be able to present to our readers, accompanying this article, portraits of some of the above named gentlemen.

EXPANSION OF BOILERS BY HEAT.

A. C. KIRK, in a recent discussion on "Hard Firing in Boilers," gives it as his opinion that the expansion of the material of boilers, and the strains that frequently cause them to leak are largely due to irregular heating, and this irregular heating must be greatest in the largest boilers whose various surfaces are exposed to very different temperatures, says the Scientific Machinist. Thus, the temperature of the flues of a Lancashire boiler being much higher than that of the shell, its movement must necessarily be greater. This would be an argument in favor of boilers of compact form like those used in ships. It has often been observed that new boilers, that is to say, boilers having clean inner and outer surfaces give much better results in steaming than those that have been in service for months, and this is used as a reason for decrying the tests of new

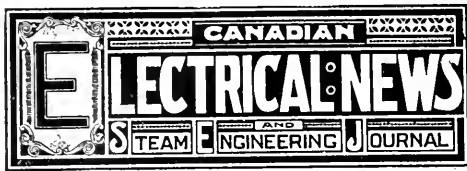


MR. JAS. D. DAVIS, Junior Member of Wm. Davis & Sons.

boilers as a standard of duty. Nevertheless the duty of a new boiler could be kept up till it was worn out if it were fed with pure water and fired with gas or other smokeless fuel. So the results of test should rather be taken as standards of efficiency to be worked up to. This is all the more feasible since various methods of forced combustion render it possible to burn slack, steam coal, gas coal, patent fuel and anthracite in the same furnace, and equally without smoke.

The problem of raising steam in a boiler begins with the burning of the fuel, which must be consumed at the required rate and burned completely so as to keep the heating surfaces as clean as possible. The heat has to be communicated to the water with the smallest loss on the way, and the steam has to be used in the least possible time after production, in order to work with economy.

Notice of application for the incorporation of the Willson Carbide Works of St. Catharines, Limited, has been given. The object is the manufacture of calcium carbide and any other metallurgical substances, the capital to be \$200,000. The incorporators are: Thomas Leopold Willson, St. Catharines; E. A. Neresheimer, New York; A. M. Scott, Woodstock; John Garry, St. Catharines, and R. G. Cox, St. Catharines. Messrs. Willson, Neresheimer, Scott and Garry will be the provisional directors.



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The Electrical News will be mailed to subscribers in the Dominion, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 5 cents is added for cost of discount. Money sent in unregistered letters will be at sender's risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrears are paid. Subscribers may have the mailing address changed a few times as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto.

JOHN CARROLL, Sec.-Treas. Eugene F. Phillips Electrical Works, Montreal.

C. B. HUNT, London Electric Company, London.

F. C. ARMSTRONG, Canadian General Electric Co., Toronto.

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Vice-President, E. J. PHILLIPS, 111 Cumberland St., Toronto.
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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. John Fox, President; Chas. McSoley, Vice-President; T. Eversfield, Recording Secretary, University Crescent.

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ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Beauséjour street, Montreal. R. Drouin, President; Alfred La Tour, Secretary, 306 Delisle street, St. Cuneo.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. C. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Macdougall's Hall. Wm. Norris, President; E. Teeter, Vice-President; Jas. Ironsides, Corresponding Secretary.

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LONDON BRANCH NO. 5.—Meets once a month in the Huron and Erie Loan Savings Co.'s block. Robert Simmie, President; E. Kidner, Vice-President; Wm. Meaden, Secretary, Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7:30 p.m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month in Borbridge's hall, Rideau street; Frank Robert, President; F. Merrill, Secretary, 352 Wellington street.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. J. R. Urley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Tuesday in each month in Fraser Hall, King street, at 8 p.m. President, F. Simmons; Vice-President, J. W. Tandy; Secretary, A. Macdonald.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

WARTON BRANCH NO. 13.—President, Wm. Craddock; Rec.-Secretary, Ed. Dunham.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outhwaite, President; W. Forster, Vice-President; A. E. McCallum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening. President, Archibald Franklin; Vice-President, John Grundy; Recording Secretary, James Atkins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

BOILER explosions are principally due to two causes, viz., defective steam apparatus and ignorant or careless engineers and firemen. The extent to which these causes exist is shown by a tabulated statement of boiler explosions for the past sixteen years, which was submitted at the annual convention of the National Association of Stationary Engineers held recently in Buffalo. The explosions during this period aggregate 3,586, involving the loss of 4,508 lives, 6,348 cases of serious injury, and damage to property in 13½ per cent. of the explosions amounting to \$8,288,370. These figures speak volumes in favor of the better education of the engineer and the periodical inspection of steam producing apparatus.

Sunday Cars.

In connection with the revival of the Sunday car agitation, the City Council of Toronto have obtained from prominent legal gentlemen, including Sir Oliver Mowat, Minister of Justice, the opinion that as a condition of submitting the question of Sunday cars to a vote of the citizens, the Council have the power to impose such special conditions upon the company as they may deem advisable. One would suppose that the most important consideration, especially from the standpoint of those who hold that a Sunday service is objectionable, would be to secure a properly regulated and limited service. It is surprising to observe, however, that the special condition insisted upon by the anti-Sunday car element in the Council, is that the company shall be compelled to grant a three-cent fare on Sunday. It cannot be doubted that cheap fares are an inducement to the citizens to use the cars. That being the case, is it not highly inconsistent on the part of those who declare that Sunday street car traffic is demoralizing, to compel

the street railway company to offer the citizens the greatest possible inducement to patronize the cars on Sunday.

The Canadian Westinghouse Company. A DISTINCT addition is to be made to the electrical manufacturing industries of Canada, by the establishment at

Hamilton of a branch manufactory of the Westinghouse Electrical Manufacturing Company, of Pittsburgh, Pa. All the arrangements to this end, including the purchase of the McKechnie factory building, and the granting of special privileges by the city, have been concluded, and the works are expected to be in operation early in the new year. The Canadian company will be known as the Westinghouse Manufacturing Co., Limited, of Hamilton. The names of the incorporators are: Messrs. George Westinghouse, Henry Herman Westinghouse and John Caldwell, all of Pittsburgh, manufacturers, and the Hon. James M. Gibson and Mr. Archibald E. Malloch, of Hamilton. Messrs. H. H. Westinghouse, the Hon. James M. Gibson and Archibald E. Malloch are to be the provisional directors of the company.

A Fair Method of Appointment.

It has been usual in the past for a great deal of wire-pulling to be done to secure the position of engineer in large public buildings. In consequence it frequently happened that the man who was best equipped by knowledge and experience failed to get the position. In other words the man with the greatest amount of "pull" got the appointment over the heads of men who were better qualified, but were no good as wire-pullers. We are pleased to observe that these conditions are not to be allowed to prevail in connection with the new city buildings now approaching completion in Toronto. At a recent meeting of the City Council a resolution was adopted that the stationary engineer to be placed in charge of the boilers and heating of the buildings be appointed after a competitive examination. It begins to appear as if those engineers who aim to secure the good positions in the future must rely less upon their ability to pull wires and more upon their knowledge of engineering.

The Power of Niagara.

THE company which is utilizing the power of Niagara Falls on the American side has paid the Ontario government the sum of \$25,000 per year for several years past for an option to the exclusive privilege of utilizing the water power on the Canadian side also. The term of this option will expire in two years, and the government are being urged not to renew the arrangement, as Canadian capitalists are prepared to utilize the power of the Canadian Fall if the opportunity of doing so is given them. It is improbable that the American company will let so valuable a privilege slip through their fingers unless they should find ample scope for their capital and ambition in connection with their huge enterprise on the American side. But if they do forfeit it, the Ontario government should consider very carefully the terms on which such privileges should be granted in the future. The success which has attended the methods employed for the utilization of the power of the American cataract permits of a more accurate estimate of the possibilities in this direction and consequently of the value which should be placed upon exclusive rights to the use of the power. There is no

doubt whatever that before many years shall have passed the means will be found of transmitting power from Niagara to the towns and cities in and adjacent to the Niagara peninsula. If it is deemed wise to grant exclusive rights to one company, the period for which such rights are to be granted should be one of reasonable limit, and the revenue received by the province should be carefully proportioned to the prospective value of the privilege. As a method of disposing of the privilege to the best advantage the government might publicly invite bids for the franchise.

A Long-Distance Power Transmission Scheme.

THE scheme for the transmission of electric power by the Keewatin Power Co., from Keewatin to Winnipeg, which was the subject of comment last year, is not dead as might be supposed, seeing that nothing has recently been heard about it. On the contrary we learn that the Power Company have employed a competent electrical engineer to go thoroughly into the possibilities of the enterprise and to formulate plans and prepare specifications upon which tenders for the required plant may be based. Not only has this been done, but we understand that tenders have actually been submitted by the Royal, Westinghouse and General Electric Companies, and their merits are now being considered. It is rumored that the line potential proposed is between 25,000 and 30,000 volts. The distance between the terminals of the line would be 120 miles. This is one of the most ambitious power transmission schemes which has yet assumed tangible form; its further development is therefore a subject of wide interest.

Qualification of Wiremen.

At the present moment, the only qualification that a man must have, in order to apply for a wiring job, is the possession of a screw driver and hammer, and the cheapest man gets it. Whenever a town is being lighted, a host of perfectly irresponsible men settle there and go about canvassing for installations, which they put in without any reference to the general wiring plan of the town, and in many cases, in the most unworkmanlike manner. The consequence is, as has been already pointed out in these columns with reference to a particular case, that no coherent scheme is possible, and that in two adjacent houses lamps will be subjected to pressures differing at any moment, by so much as three volts. In one large hotel in a small provincial town, a test shewed that lamps in two adjacent rooms that formed the termini of two branches, had six volts difference in their pressures. This is, it is to be hoped, an unique case, but it illustrates the evils of allowing anyone to do wiring. An examining board might be formed, including representatives from the Fire Underwriters, the Canadian Electrical Association, the larger manufacturing companies, and from some of the larger operating companies, who would examine candidates as to their knowledge of wiring rules and methods, their knowledge of practical electricity, and their acquaintance with central station economies. Certificates would follow of two or three classes, shewing that the examinee had been found competent by reading or experience to (a) entirely manage a central station plant, both alternating and direct current, steam or water power, both the plant and the business; (b) merely look after the electrical machinery, as dynamo tender and electrician, to effect repairs and make extensions; (c) do the wiring in houses or

streets. B would include C. It is not to be expected that this proposal would immediately find acceptance. Old timers, who "know it all" already, would treat it with contempt, but there are many companies who would gladly avail themselves of the assurance afforded by such a certificate of the competence of their employees, and who would even hold out higher pay inducements to their staff, in order that they might qualify themselves for it. At first, of course, it would be no proof of incompetence if a man did not hold such a document, but it would always be strong argument in his favor if he did. A board of examiners could be selected, the personnel of which had such unquestioned standing in the electrical profession that their endorsement would carry weight and disarm criticism. We shall be glad to have expressions of opinion on this matter from central station men.

We are convinced that the general level of electrical knowledge would be raised by the inauguration of such an innovation. There would, in course of time be an emulation among the younger and more ambitious members of the profession, which would lead to more careful and thorough study, and a rapid dissemination of knowledge that could not be other than beneficial both to those who operate power houses and those who draw dividends from them. The opinion that now seems to obtain, that competent knowledge of electricity is to be acquired by "induction" so to speak—that a man who works around dynamos and lamps for a couple of years is a thoroughly well posted "electrician," would become less strong in proportion as study became more general; for of no science is the saying more true than "the more a man studies the less he knows."

THE specifications for the plumbing
Wiring Specifications. work for the new municipal buildings in Toronto, have given rise to very unfavorable criticism at the hands of some prominent manufacturers of heating and sanitary apparatus; and we should like to suggest that the electrical manufacturing industry has an equal cause for complaint, and on similar grounds. The plumbers' complaint is that the specifications, instead of calling for apparatus of "any" make, but imposing a certain particular make as a standard of excellence, seem to impose as a condition that none but one particular make shall be supplied, thus imposing limitations that practically withdraw the matter from open competition. In the electrical work also—which, by the way, in the interests of the public, we should like to know was being planned by an electrical specialist, certain particular conduits have been named in the specifications to the exclusion of others, equally excellent. Why should this be so? Specifications should, no doubt, be so drawn up as that none but suitable machinery and apparatus could be tendered for thereon, but it seems to be hardly in the public interests to expressly favor one class of manufacture at the expense of others, when the bona fides of all manufacturers can be insured by specifying appropriate tests. And one other matter we would draw attention to—why include electrical wiring with the plumbing and heating work? What obvious connection is there between a plumber and an incandescent wireman? Would it not have been as well to make a separate contract for this work?

Status of the Electrical Engineer in Canada.

Good engineering is the great want of the day in electrical matters, and if works that are distinctly electrical enterprises are carried on by members of other engineering specialties, it is not because there are no electrical engineers in Canada. McGill College turns out electrical specialists who are sought for to fill the most responsible positions in the United States; the School of Practical Science in Toronto gives a most admirable technical training; and there are electrical courses in Kingston R. M. C., the Toronto Technical School, and other institutions; and yet it is doubtful whether the electrical profession has even a status in Canada. The engineering of electric lighting plants, power transmissions, and railways, is placed in the hands of architects, sanitary engineers, provincial land surveyors—anybody but electrical engineers, and the results are just what might be expected. Architects and civil engineers require all their time to keep themselves posted in their own business; and it is not to be expected that they can keep themselves up to the times in electrical matters where improvement is so rapid along many differing lines, and where the text book knowledge of ten years ago is left behind in the dark ages. Special training is necessary in order to qualify anyone to follow along the march of electrical progress, without falling far to the rear; and it is inevitable that specialists in other branches, even highly educated civil engineers, will merely voice the ideas of some particular electrical manufacturing company, to which they have referred for technical assistance.

PERSONAL.

The employees of the Great North-Western Telegraph Co. presented Mr. W. D. Toye with a marble clock on the occasion of his recent marriage.

Mr. Wm. A. Sweet has resigned his position with the Hamilton, Grimsby & Beamsville Electric Railway to accept the position of chief engineer of the Hamilton Radial Electric Railway.

Mr. Robt. A. Ross, who was for some years chief electrical engineer with the Royal Electric Co., and previously occupied a similar position with the Canadian General Electric Co. has commenced business in Montreal as a consulting mechanical and electrical engineer.

Mr. G. F. Cummings, an eminent electrician, was recently in Toronto in the interests of the Conduit Electrical Company, of Detroit, who are considering the question of opening a branch in this city. Mr. Cummings is well known in Toronto, being at one time in charge of the engineering department of the Edison Electric Light Works.

Mr. D. H. Keeley, Superintendent of Government Telegraphs, has returned from an inspection trip in the east, after an absence of two months. Taking the government cable steamer Newfield, he repaired the cables between the Magdalen Islands and Cape North, and between St. Paul's Island and Cape North, also the Bay of Fundy cable to Whitehead Island.

We learn that the statement we published in our last issue that Mr. C. F. Medbury had accepted a position with the Western Electric Co., of Chicago, is incorrect. Mr. Medbury is at present acting as consulting engineer to Mr. Horace Beemer, promoter of the Quebec Electric Railway Co., and to the promoters of electrical enterprises in other parts of Canada. The wish of his numerous friends is that he may find sufficient employment for his talents to warrant him in again taking up his residence in Canada.

By a special car of the Winnipeg electric street railway, twenty-four Indian children from the Brandon Industrial Institute were recently conveyed to the power house, where Mr. Glenwright, superintendent of the railway, explained to them the operation of the machinery. The children are said to have evinced great interest in their visit.

BY THE WAY.

As an illustration of the power-consuming qualities of a modern pulp mill, it may be mentioned that the mill at Grande Mere, Quebec, requires for its operation 6,000 horse power, or an amount equal to that at present consumed by all the industries of Hamilton. What a big coal pile would be required to keep the machinery of this mill in operation, if it were not located in a country of magnificent water powers.

x x x x

I NOTICED in passing the Toronto Industrial Exhibition Grounds the other day, that the rails used for the operation of the pioneer electric railway on the Van Depoele system, by means of which ten years ago visitors were carried from Strachan Avenue to the Fair grounds, are still in position. Are they being kept on exhibition as one of the curiosities of the Fair? If not, the wonder is that the management has not before this converted them into cash at the price of old iron.

x x x x

I AM told that the British Columbia mining boom has already proved to be a good thing for the Canadian telegraph companies, whose western business has expanded considerably since the gold fever set in. It is to be regretted that owing to the lack of railway communication, our eastern manufacturers and supply houses, do not secure for their goods the British Columbia market, which of right should be theirs, and which if open to them would greatly stimulate business in eastern Canada.

x x x x

PETROLIA, the headquarters of the Canadian petroleum industry, is now lighted by electricity. Naturally enough the shareholders in the oil companies opposed the introduction of the modern illuminant, no doubt on the ground that to do otherwise would be tacitly to admit that coal oil lighting is an out-of-date method. The battle between these interested champions of old-time methods and the progressive element of the community was waged for many months, before victory for progress was achieved. Following close on the adoption of modern lighting the town has set about the construction of an extensive and costly water works system, and seems to be determined to be in every respect a thoroughly up-to-date community.

x x x x

AN acquaintance of mine, a competent electrician, who has been endeavoring to secure a situation as superintendent of a lighting station, writes me in the following vigorous fashion: "I am entirely disgusted with the electrical business. Central station owners want a first-class man to work for nothing. They expect all the best requirements for about 35 to 40 dollars per month. In fact they want a 'fireman and electrician.' Anything that can use the coal shovel is good enough to run a central station, and as to wiring, so long as a man can get up a pole that is all that is required. The ability to shovel coal, climb a pole, put a pair of carbons in an arc lamp and sling oil around the power house are the essential requisites." I fear that there is more truth than poetry in the above complaint. Men buy expensive machinery and put it in charge of ignorant, careless attendants, because their services can be had for less money than would be required to pay competent men. The apparent saving in salary, is the point on which their attention is fixed; with such men frequent break-downs, unnecessary wear and tear of machinery, inefficiency of production, waste of supplies, and the

hundred and one leaks, pass unnoticed. A little careful enquiry in these directions would show that the losses arising throughout the year from these causes would suffice to pay many times over the additional sum necessary to secure the services of a thoroughly competent superintendent. My friend's letter reveals I believe one of the principal reasons why many electric lighting plants do not pay, and the sooner the owners of such plants come to recognize that profits are contingent upon good management, the sooner will the electric lighting business take a step upward, and rank with other enterprises from which satisfactory profits are derived.

x x x x

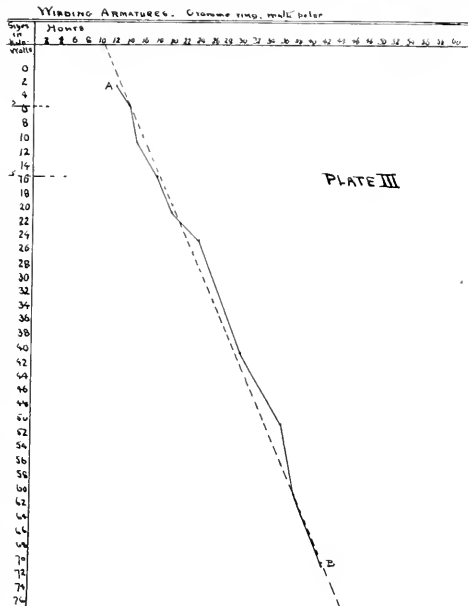
I AM reminded by a conversation I had with a citizen of Dundas the other day, that it is an unwise policy on the part of holders of public franchises not to cultivate in every possible way the good will of the citizens of the municipalities upon which they must largely depend for support. This man, who claimed to voice the sentiments of the community, complained very strongly of the attitude of the management of the Hamilton and Dundas Railway Company towards the town of Dundas. He claimed that the Company had no intention of transforming the road into an electric road, but were trying to put the town in the position of being compelled to contribute by way of bonus to the funds of the Company a sum of about \$2500 per year for all time. He complained of the action of the Company in making a charge of 10 cents for small parcels which passengers could carry on their knees, and for which formerly no charge was made, and said that the lack of consideration in such particulars had given rise to a feeling of antagonism on the part of the citizens towards the railway Company, as a result of which an effort would probably be made to induce the Hamilton Street Railway Company to extend their lines to Dundas by way of the main street of the town, over which and one or two other streets the Hamilton and Dundas Company does not control the right of way. There is no doubt that if a trolley line were in operation between Hamilton and Dundas, it would at once capture the traffic and render the present steam road a valueless piece of property. As to whether the complaints preferred against the present Company are well founded, I have no means of knowing, but it is at least unfortunate for the Company that citizens of the town should feel themselves called upon to give public expression to opinions which must tend to deprive it of the good wishes and cordial support of the community. In this connection I may mention that the Company are at present putting down new rails, and it is said to be their intention to put on some new cars

A new design in steam engines has been patented in Canada, United States and Europe, by Cleveland and Peterson, of Brandon, Man. One engine on this pattern has been built at Ritchie's machine works, Hamilton.

The Town of Chatham, Ont., is considering the question of installing an electric light plant, to be controlled by the town, and has secured the following statistics relative to the cost of operating similar plants in other towns. Chatham, 65 lamps, all night, 23½ cents each per lamp; Brantford, 55 lights, all night, 23 cents; Cobourg, 23 lights till midnight, 21 cents; Port Hope, 33 lamps till midnight, 15 cents; Peterboro, 25 cents per light all night; Ingersoll, 30 lights till midnight, 20 cents; Woodstock, 70 lights till midnight, 10 cents; Belleville, 61 lights, all night, 24 cents; Galt, 50 lamps, 22 cents till midnight; Hamilton, 369 lights, all night, 25 cents; Guelph, 90 lights, all night, 24½ cents; Owen Sound, 30 lamps, all night, 30 cents; London, 300 lamps, all night, 25 cents.

It may be mentioned at once that the working out of such a scheme must be left entirely in the hands of the Works Manager, and must not be left in the hands of clerks, as they generally lack the judgment necessary in this regard, or even to accountants, however capable they may be as accountants. The latter from the nature of their training are wedded to exact balances, and would shudder at an approximation.

To start with, and to stick to the example shown above: the factory is engaged in building direct current dynamos and motors, and the cost of manufacturing is required. Lists of the constituent parts of the different sizes of machine, classified under



the headings of their essential parts must first be prepared (see Plate I and Plate II). The weights in the rough on Plate I must be taken from the best average that can be obtained from Plate II. It should be the duty of the receiving clerk to keep Plate II (which is a first-class birds-eye view for the manager, over the foundry weights) posted up to date.

The drawings and engineers' data will give the theoretical quantities of other material, and a few careful observations of the amounts actually used must be made under the personal supervision of the Works Manager. Space will not permit a more elaborate illustration of these details.

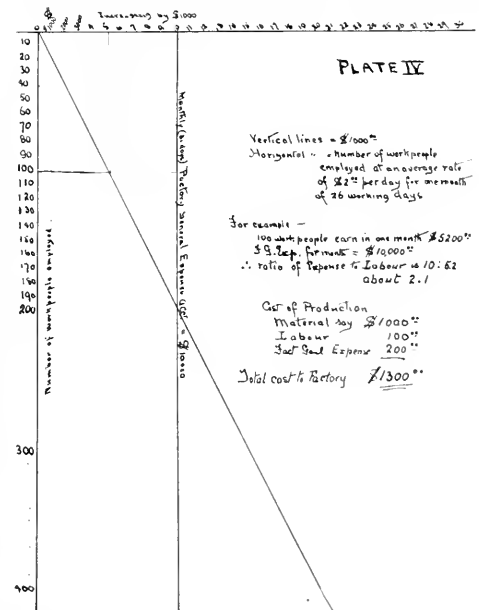
The labor is the next thing to consider; there is the labor which is strictly productive, and there is that which is so often dumped into a general expense account. In the first, if the whole shop is on piece work, finding the cost is more or less of a simple matter; if otherwise, reliable figures must be obtained from an average over many observations. Taking the latter case, it is advisable to commence with, to get one good observation on several different sizes of the same type, and plot them on cross-section paper as shown in Plate III. This gives a good basis on which to approximate the time taken on intermediate sizes, viz: by simply following the horizontal lines to the curve A.B., and reading on the perpendicular lines the number of hours as shown. Experience has proven that an approximation such as this is not merely guess work, but differs very slightly (a fraction of a percentage) from the afterwards ascertained actual facts. Theoretically the curved line A.B. should be the dotted straight line A.B., but there are practical considerations which prevent it. This curve is only a preliminary one, and fresh observations must be made from time to time to check it, and to demonstrate the fact of its deviation from the dotted line A.B., being due to good practical reasons.

Next comes the labor which is so often confounded with expense. For instance, handling, painting, extra chippings on castings, helpers to operatives, etc. There seems to be no legitimate reason for not classing this in with the productive labor; it is a labor cost on the machine, and can be accounted for directly. This labor can be approximated in the same manner as the purely productive labor as shown by Plate III. It is, however, a some-

what more variable quantity, and requires the average of several very close observations on the extreme, and two or three intermediate sizes before plotting the curve. Works Managers will at once see the strength of this caution, recognizing as they do, that this class of labor is one of the "little foxes" which play such sad havoc with the cost of production.

Finally the general expense of the factory is to be accounted for. In the Factory General Expense account care must be taken to EXCLUDE all expenses of the selling offices, advertising, and freight on finished product, in short all expenses outside the factory gates. Clearly understanding this, the method of apportioning to material and labor as above, the true proportion of factory general expense is very simple. It is understood, of course, that under the heading of material is included freight, cartage, duty and other dues; under labor is included all operatives, and their helpers' pay, laborers handling the raw material or product in any form; in brief, the pay of all persons handling the material inside the factory gates, otherwise than storekeepers. Factory General Expense includes managers, foremen, clerical help, storekeepers, expenses of light, heat and power, rent, insurance and other charges incidental with running the factory. It is readily seen by this that the factory general expense bill is practically a fixed quantity, whereas the Labor bill is a quantity varying with the busy and slack seasons. Expense bears to Labor a definite relation, and on the contrary has no relation to Material. To explain this more fully:—Factory General Expense is the salary of the personnel and the incidental running expenses as shown above, and can be lowered to a very slight extent, if to any, during slack seasons, while on the other hand, the number of productive employees has to be increased or decreased according to the work on hand. Thus in a busy season the factory general expense may bear the relation of five dollars expense to five dollars of operatives' wages, in a slack one the five dollars expense remains fixed, whereas the operatives' wages bill is only one dollar.

All that is necessary now is to get an exact statement from the Accounting Department of the charges to Factory General Expense



over a definite period, the longer the better, and make a diagram as in Plate IV.

Plate IV not only demonstrates the fact without figuring that the Factory General Expense piles up the actual cost of production considerably higher in slack than in busy seasons, but it gives the manager a simple and ready-reckoner in figuring against a close call from competing firms and saves the nerve-racking uncertainty of adding arbitrary percentages for the safety margins.

The above, although badly cramped from its necessary conciseness, should be a fairly lucid demonstration of a simple and cheap method of "cost making," which eliminates almost entirely the personal equation, viz: the arbitrary percentage margins, and

unsystematic guess-work allowances so very much in vogue in many of the most up-to-date companies.

The figures herein shown are strictly systematic and scientific, and it cannot be contended that such approximations are in any way guesses.

THE STEAM ENGINE.

By JOHN C. GOUGH.

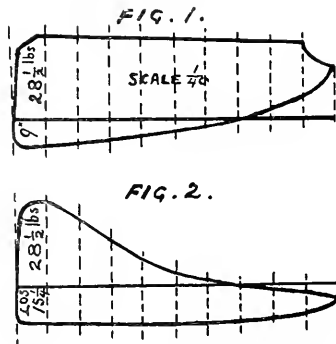
Those of us who have made for ourselves a toy engine (and I am inclined to believe that the number will be found not inconsiderable), and have watched it doing its whirling revolutions of some 2,000 or 3,000 per minute, might naturally be led to the conclusion that there was no limit to the velocity with which steam can travel, or to the speed with which it can enter and pass out of the cylinder, and its motion be changed or reversed. Such a notion would be, however, erroneous in the extreme, as the speed at which steam travels on its way to or from the cylinder of a steam engine is an important factor in determining the best size of the steam passages, ports, etc. It has been found by experiment that so long as the steam in a pipe is not required to travel at a higher rate of speed than 100 ft. per second, or 6,000 ft. per minute, the loss from friction, etc., in the pipes and passages is not a serious one, and the pressure at which it can be obtained on the piston is not much reduced from the boiler pressure. Beyond this speed, however, serious loss of pressure takes place, and hence the importance of having the steam ports so large that the velocity referred to may not be exceeded.

Those engineers who have had much experience in the overhauling of steam engines, are aware that in a large number of old engines the ports and passages in the cylinders are very much too small. In a case which recently came under the notice of the writer, the area of the steam port was not more than one-thirtieth of the cylinder area, and the loss from wire-drawing, poor vacuum, etc., was in consequence very considerable, although the piston speed was not a high one.

When the steam ports and passages of an engine are too crippled, there is, in addition to the loss from wire-drawing, etc., a further loss of power from the increased resistance to the exit of the steam from the cylinder, causing what is known as "back-pressure."

In condensing engines, even though there may be a plentiful supply of cold water and good "vacuum" in the cylinder, when the exhaust passages are tortuous, and contracted, an exceedingly poor effect of the vacuum will be obtained in the cylinder.

Perhaps, as good an illustration of this as could be obtained is shown in the diagrams (Figs. 1 and 2) taken from a condensing



engine a few months ago. The engine was furnished with a cut-off valve, by means of which the steam could be cut off at any desired portion of the stroke. In Fig. 1, it will be observed, the steam is admitted during about nine-tenths of the piston's stroke, and when released, escapes with such difficulty through the contracted exhaust passages, that the back-pressure exceeds that of the atmosphere during three-tenths of the return stroke, and, at the termination of the stroke, when the full effect of the vacuum is usually obtained in the cylinder, there is an absolute back-pressure of something like 6 lbs.—that is to say, to use the common expression, the "vacuum" is only 9 lbs.

Fig. 2 was taken from the same engine and immediately after Fig. 1, when driving a much lighter load, and the steam cut off about 1/4th the stroke. The quantity of steam to be condensed is here so much less that a "vacuum" of 13 1/2 lbs. is now shown in the cylinder, and although the effect of the restricted exhaust is

still seen at the commencement of the exhaust, a very much greater effect is obtained from the vacuum throughout the stroke than under the conditions shown in Fig. 1. Hence we see, that besides the loss of pressure in admission when the ports and passages are too small, an even greater loss is experienced from the back-pressure, resulting from the resistance to the egress of the steam.

Many rules have been given for determining the size of steam ports, etc., but none can be considered as other than empirical which does not take into account the fact above mentioned, viz., that the velocity of the steam in following a piston should not in the passages exceed 100 ft. per second, or 6,000 ft. per minute. Bearing this in mind, we shall see that the area of the steam ports should have the same ratio to the area of the cylinder that the piston speed in feet per minute has to reach 6,000, from which we easily deduce a rule, thus:

$$\text{Area of port} = \frac{\text{Area of Cylinder} \times \text{Piston speed in feet per minute}}{6,000}$$

A rule in very general use amongst engineers and to be found in most engineering pocket-books, is to make the area of steam port equal to 1/16th the area of the cylinders. Let us see how this corresponds with the rule we have just found. Take for example, say, an engine having 5 feet stroke running 50 revolutions per minute: that is to say, with a piston speed of 500 feet per minute. By our rule we have,

$$\text{Area of port} = \frac{\text{Area of Cylinder} \times 500}{6,000} = \frac{\text{Area of Cylinder}}{12}$$

so that we see for 500 ft. piston speed, the common rule for making the steam ports equal to 1/16th the cylinder area would give too small a passage, the port requiring to be not less than 1/12th the cylinder area, in order not to lose pressure and power from the entering steam having too high a velocity. If the piston speed were only 400 ft. the port might be made only 1/15th area of cylinder, because

$$\frac{\text{Area of Cylinder} \times 400 \text{ ft. per minute}}{6,000} = \frac{\text{Area of Cylinder}}{15}$$

and so on if the piston speed were still further reduced; the common rule would give a larger steam port than is necessary. In order to avoid the great loss experienced by restriction of the exhaust, as shown in the above diagrams, it is customary to make the exhaust ports about half as large again as the steam ports, so that the egress may be as free as possible, and the back-pressure on the piston reduced to a minimum.

There being then so much advantage in having large passages to and from our cylinders, the consideration naturally arises as to what conditions determine the limits in the opposite direction, or can we really make the steam passages and steam ports too large? It is well known that too much "clearance" space at the ends of the cylinder means loss of steam at each stroke of the piston, and in the same way an excessive capacity of steam port or passage would mean waste, through more steam having to be thrown away in exhausting than is really necessary. A further consideration respecting the disadvantage of having too great width of area of ports is found in the cooling influence of the exhaust steam, the temperature of which, at or below the atmospheric pressure, is very much lower than that of the fresh steam at its entrance to the cylinder. The passage of the exhaust steam through the ports as the high-pressure steam has to pass through, abstracts a considerable amount of heat from every part of the metal with which it comes in contact, and this heat has to be supplied again by the entering steam at each stroke. The question, therefore, of having the steam ports of an engine a proper size, neither too small, so as to cause loss by wire-drawing, back-pressure, etc., nor too large, so as to give rise to loss from cooling, etc., it will be seen is one which has a material influence on economical working. The rule here given is a practical one of long personal experience and one which the writer can recommend.

The steam ports in Corliss engines are, in usual practice, 1/12th, and exhaust ports 1/15th of the piston area. The piston speeds, of course, govern the application of those rules in nearly every instance.

MONTREAL, QUE., 12th Oct., 1896.

The Spokane and British Columbia Telephone and Telegraph Co. propose constructing an international telephone line between Washington and British Columbia. Arrangements have been made for connection at Spokane with the Inland Telephone Company, and on the British Columbia side with the Vernon and Nelson Telephone Company's system.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO NO. 1.

TORONTO NO. 1 held their regular fortnightly meeting in Engineer's Hall, 61 Victoria street, on Wednesday evening, 21st ultimo, at which one candidate was initiated. After the regular routine of business, Bro. Cross gave an interesting "chalk talk" on figures, and was presented with a hearty vote of thanks.

The Library Committee reported that the first of a series of book cases was on view in the library room, and that upwards of 100 volumes were already on the shelves. They wish to thank those who have been kind enough to donate to this work, and to state that they would be pleased to hear from the manufacturers or others who feel inclined to assist this branch of the Association's good work.

The Banquet Committee reported that they had made arrangements for the tenth annual banquet, to be held at the Palmer House on November 25th (Thanksgiving Eve). This hotel is centrally located, at the corner of King and York streets, and the dining hall has facilities for accommodating 300 guests. The secretary of the committee hereby extends a hearty invitation to all members of the C. A. S. E., and hopes that in case written invitations are not received all officers and members will consider the above invitation sufficient.

G. C. MOORING, Sec. of Com.

15 Charlotte street.

QUESTIONS AND ANSWERS.

A. B. C., Ontario, writes: "Please give the horse power or friction load of a 100 horse power high speed engine belted direct to a slow speed alternator of 1000 lamps capacity; also the horse power required to charge two miles of primary line (without any lamp on) and transformers of 1000 lamps capacity."

ANSWER.—It is impossible to give quantitative answers to your questions. The friction load of an engine belted to a generator, depends on many very variable quantities, such as condition of bearings, state of belt, make of engine and generator, etc. About ten horse power, however, should not be exceeded, on running everything empty in your size of plant. Your second question is even more impossible than the first. By the expression "charge" when you ask the horse power required to "charge" 2 miles of line and transformers, we think you mean, that if a primary line two miles long has transformer primaries connected up to a capacity of 1000 lights, and the secondaries are left open; then how much current will the ammeter indicate? In other terms, you want to know the magnetizing current of transformers to a capacity of 1000 lamps. There is no rule for this; the magnetizing current depends, in amount, on the design of the transformer, the materials of which it is constructed, its capacity; a large transformer will generally require a smaller magnetizing current, in proportion, than will a smaller one of the same make; and you will find that transformers of to-day, which embody the principles of design and construction which have been arrived at by careful scientific investigation, will prove considerably more economical on this point than are those which were

made a few years ago, before transformers had received the study which has been devoted to them during the past two or three years. You will also find that the general idea that a transformer is the easiest thing in the world to make, is erroneous. We are sorry that our answers are necessarily so very indefinite, but the questions themselves do not admit of anything more so. The manufacturers of your transformers have probably made observations of the magnetizing current, and might give you information.

ELECTRICAL DEVELOPMENT IN EUROPE.

L'INDUSTRIE Electrique publishes the following figures in regard to electrical development in Europe: There are 560 miles of electric roads in Europe, which is an increase of 125 miles in one year. The number of electric cars has increased from 1236 to 1747 in the same time. Germany has 250 miles of electric roads and 857 motor cars. France has 82 miles and 225 motor cars. Great Britain has 65 miles, with 168 cars, and Austria-Hungary has 45 miles, with 157 cars. Next comes Switzerland, Italy, Spain and Belgium, in the order given, while Russia has but one electric railroad, with 6 miles of track and 32 motor cars, and Portugal ends the list with 178 miles. Of the 111 European lines 91 are overhead trolleys, of which there were 35 in Germany, 12 in Switzerland, 10 in France, and 7 each in England and Italy, and 6 in Austria-Hungary, etc. Of electric railroads with underground current there were but three at the beginning of this year, one each in England, Germany and Hungary. Nine lines are provided with an insulated central track, through which the current is conducted, eight of these railroads being in Great Britain and one in France. The remaining eight lines are provided with accumulators. Of these, four are in France and two in Austria, and one each in England and the Netherlands.

SPARKS.

At the annual meeting of the Nanaimo, B. C., Telephone Company, held early in October, the following directors were elected: Messrs. J. C. Armstrong, O. Plunkett, M. Bray, E. Pinbury and G. Norris. Subsequently G. Norris was chosen president; J. C. Armstrong, vice-president; W. K. Leighton, secretary and collector, and G. E. T. Pittendrigh, manager.

The Royal Electric Company are installing for the Sussex Water and Electric Company, Sussex, N. S., one of their 40 k. w. "S.K.C." two phase generators, with 360 to c.p. lights capacity in transformers, and are wiring up the town. The Sussex Company are supplying both arc and incandescent lighting, as well as motors from the same dynamo and circuits. With the continued improvement in alternating arc lamps, it is now quite feasible to do this. A number of plants are now in operation furnishing arc and incandescent light, as well as motors from the same dynamo and circuits; excellent results are reported. The use of motors makes it possible to run the plant the full 24 hours with increased capacity.

The shareholders of the Merchants' Telephone Company, Montreal, held their annual meeting on the 7th of October, Mr. F. X. Moisan, the president, in the chair. The annual report stated that two hundred and thirty-one new telephones had been placed during the past year, making a total of over 900 now in operation. The treasurer's report showed a surplus of \$19,000. It was decided to negotiate a further loan of \$45,000 to extend operations. The following gentlemen were elected directors: F. X. Moisan, L. E. Beauchamp, J. E. Beaudoin, A. S. Delisle, G. N. Ducharme, L. H. Henault, M. T. Lefebvre and F. Dagenais. At a subsequent meeting of the directors, Mr. F. X. Moisan was re-elected president, Mr. A. S. Hamelin, vice-president and L. E. Beauchamp, treasurer.

GAS CYLINDER EXPLOSIONS.

A GOVERNMENT committee in England has made official inquiry, and found that, of nineteen cases of gas cylinder explosions in different parts of the world, four were due to carelessness, one from mixed gas or vapor due to improper compressing arrangements, four to bad cylinders, three either to bad cylinders or to an excessive pressure due to overcharging, one due to ignition from oil, and one for which no cause could be assigned. The committee recommends that in the case of cylinders of compressed gas that is, oxygen, hydrogen or coal gas and of lap-welded wrought iron, a greatest working pressure of 120 atmospheres, or 1,000 pounds to the square inch, and the stress due to working pressure not to exceed six and one-half tons to the square inch; proof pressure in hydraulic test, after annealing, 224 atmospheres, or 3,360 pounds to the square inch; permanent stretch in hydraulic test not to be more than 10 per cent. of the elastic stretch; and one cylinder in fifty to be subjected to a statical bending test, and to stand crushing nearly to flatness between two rounded knife edges without cracking. In the case of lap-welded or seamless steam cylinders, the greatest working pressure is fixed by this committee at 120 atmospheres, or 1,800 pounds to the square inch, carbon in steel not to exceed 0.25 per cent., or iron to be less than 99 per cent.; tenacity of steel not to be less than 26, nor more than 33 tons to the square inch.

BOILER SCALE AND STEAM EFFICIENCY.

DISCUSSING the subject of boilers and feed water recently, Professor F. B. Crocker made some terse remarks on the subject. The water used in steam boilers is obtained either from the regular city water supply or from some source such as a pond, river, or well. Which of these is best to employ depends upon the circumstances in each particular case, but in almost every instance the question of the purity of the water is an important matter. Almost any water available for use in boilers contains from 10 to 100 grains of solid material per gallon, and since a 100 horse-power boiler evaporates about 30,000 pounds of water per day of ten hours, or about 400 tons per month, the accumulation of this material becomes very considerable, assuming only half of it to be deposited. Impurities of water are of two distinct kinds: First, small particles of solid material mechanically held in suspension, the presence of which is perfectly evident to the eye, forming what is called, in plain language, muddy or dirty water. The other class of impurities are mineral substances dissolved in water, producing little or no change in its appearance or transparency. Impurities of the first kind can be removed by filtering, or by simply allowing the suspended particles to settle; but impurities actually dissolved in the water can only be eliminated by some process of chemical or physical precipitation. The so-called "hard water" is simply water containing compounds of lime, magnesia, etc., in solution, which are particularly objectionable in water for boilers, since they are deposited as a scale or incrustation upon the interior, and seriously interfere with the transmission of heat through the metal, thereby reducing the efficiency of the boiler and also introducing a danger that it will become excessively heated and weakened. These deposits in boilers sometimes reach a thickness of half an inch or more, and are extremely troublesome and difficult to prevent or to remove after they have formed.

It is estimated that scale one-sixteenth of an inch thick necessitates the use of about 10 per cent. more fuel, one-fourth inch almost 40 per cent more, and half to three-quarter inch scale actually doubles the amount of fuel required to generate a given quantity of steam. These facts, and the greatly increased repairs and danger arising from scale in boilers, show the great importance of eliminating it.

THE EFFECT UPON THE DIAGRAMS OF LONG PIPE-CONNECTIONS FOR STEAM ENGINE INDICATORS.

IF an indicator is to be relied upon to give a true record of the varying pressures and volumes within an engine cylinder, its connection therewith must be direct and very short.

Any pipe connection between an indicator and an engine cylinder is likely to effect the action of the indicator; under ordinary conditions of speed and pressure, a very short length of pipe may produce a measurable effect in the diagram, and a length of three feet or more may be sufficient to render the cards valueless except for rough or approximate work.

In general, the effect of the pipe is to retard the pencil action of the indicator attached to it.

Other conditions being equal, the effects produced by a pipe between an indicator and an engine cylinder become more pronounced as the speed of the engine is increased.

Modifications in the form of the diagram resulting from the presence of a pipe are proportionately greater for short cut-off cards than for those of longer cut-off, other things being equal.

Events of the stroke (cut-off, release, beginning of compression) are recorded, by an indicator attached to a pipe, later than the actual occurrence of the events in the cylinder.

As recorded by an indicator attached to a pipe, pressures during the greater part of expansion are higher, and during compression are lower, than the actual pressures existing in the cylinder.

The area of diagrams made by an indicator attached to a pipe may be greater or less than the area of the true card, depending upon the length of the pipe; for lengths such as are ordinarily used, the area of the pipe-cards will be greater than that of the true cards.

Within limits, the indicated power of the engine is increased by increasing the length of the indicator pipe.

Conclusions concerning the character of the expansion of compression curves, or concerning changes in the quality of the mixture in the cylinder during expansion or compression, are unreliable when based upon cards obtained from indicators attached to the cylinder through the medium of a pipe, even though the pipe is short. — W. F. M. Goss, in Scientific Machinist.

The attention of those of our readers who are desirous of becoming acquainted with the principles and applications of Roentgen rays and phenomena of the anode and cathode, is directed to a book on this subject by Edward P. Thompson, M. E., E. E., New York, and recently published by Messrs. D. VanNostrand & Co., of the same city. This book, consisting of 200 pages, reviews the history of investigations and experiments in connection with the electric discharge from the time of Faraday, Davy, Page and others, and treats of the variety of purposes to which our present knowledge of the subject may be applied. It is suggested that the study of the subject might well have a place in the curriculum of scientific schools. The book, which is illustrated with numerous engravings, sells at \$1.50 per copy.

SPARKS.

The Metropolitan street railway is being extended to Richmond Hill.

The London Street Railway Company are putting in a new 530 horse power engine in their power house on Bathurst street.

An electric light plant has been installed at Trail, B. C., consisting of an alternating dynamo of 1000 h.p. lights and an arc machine of 25 lights.

The dispute between the city of Winnipeg and the Street Railway Company has been finally settled, and arrangements are now being made to extend the line.

The Asbestos and Danville Railway Company, of Danville, Que., will apply to parliament for authority to build an electric railway from Danville to Asbestos.

George Hunt, proprietor of the St. Lawrence Machinery Supply Company of Montreal, is reported to be offering his creditors ten per cent. on claims amounting to \$3,100.

The Montreal Park and Island Railway Company expect to have their line completed to Lachine this fall. The power houses at St. Laurent and Lachine are also nearing completion.

Judgment for \$700 and costs was recovered by Mr. Nelles, ex-manager of the Hamilton, Grimsby and Beamsville Railway, in his suit against the company for alleged wrongful dismissal.

A company of Brantford capitalists are promoting a scheme for the construction of an electric railway from Brantford to Paris and Ayr, and probably to Galt. A charter for the road is held by the promoters.

The St. Hyacinthe and Granby Railway Co., of St. Hyacinthe, Que., is seeking incorporation with a capital stock of \$100,000, to build a steam or electric railway, between Bingham, Bromé County and St. Hyacinthe.

There is now in course of construction for the Ottawa Street Railway Company an electric locomotive for hauling lumber from the yards of Messrs. W. C. Edwards & Co. to the Canada Atlantic Railway after the hours of the regular passenger service.

The Chateau & Northern Electric Railway Co. will shortly complete their electric road from the city of Montreal to Bout d'Isle, a distance of twelve miles. An initial trip over the section between Maisonneuve and Point Aux Trembles, where the power house is located, was made a few days ago. Four cars have arrived from the Canadian General Electric Co., Peterboro', and two more are shortly expected.

The announcement has been made within the past few days that an international syndicate of capitalists has secured control of the largest tramway in London, England. Mr. Wm. McKenzie, president of the Toronto Street Railway Co., who some weeks ago was given a franchise for an electric railway in Birmingham, is at the head of the syndicate, and with him are associated Mr. James Ross, of Montreal, and several street railway capitalists of New York, St. Louis and Philadelphia.

The quarterly meeting of the shareholders of the Hamilton, Grimsby and Beamsville Electric Railway Company was held on the 2nd inst., when the statements of the secretary-treasurer, Mr. Adam Rutherford, for the six months ending September 30 were accepted. Mr. Rutherford was voted stock in the railway to the value of \$2,000 for his services up to March, 1894. The Beamsville extension of the road has been completed, and was placed in operation a few days ago. The annual meeting of the company will be held on the fourth Monday in January.

Arrangements have been completed by the Westinghouse Air Brake Manufacturing Company, of Pittsburg, for the establishment of a branch factory in Hamilton, Ont., and a new Canadian company will be organized, to be known as the Westinghouse Manufacturing Co., Ltd., of Hamilton. The capital stock will be \$500,000. The names of the applicants are: George Westinghouse, Henry Herman Westinghouse and John Caldwell of Pittsburg, and Hon. J. M. Gibson and A. E. Malloch, of Hamilton. It is proposed to manufacture electrical appliances and air brakes for railways, switches, etc.

Tenders for a telephone franchise for the city of Toronto, were opened a fortnight ago. Tender No. 1 was by George Mussol, who offered to establish the system described as automatic, giving absolute secret connection and a continuous service at nights. No. 2 tender proposed that the Citizens Telephone Company of Toronto (to be incorporated) would furnish the Wilhelm Telephone Company System of Buffalo. No. 3 was by Clark, Gowes & Co.,

on behalf of a client. Tender No. 4 was from Messrs. Beauchemin, Montreal, offering to furnish a service on the basis of the Merchants' Telephone Company of Montreal, at \$25 each.

The paragraph which appeared in our October number relative to the proposed electric railway at Quebec, was slightly inaccurate. We are advised that Mr. Beemer, the original promoter and owner of the franchise of the railway, has concluded an arrangement with a company for the construction of the road, which when completed and put in operation, will be taken over by Mr. Beemer.

The following figures show the prices paid for electric lighting by a number of Ontario towns:

Belleville.....	2,000 candle power.	\$127.75 per light.
Brampton.....	" "	64.00 "
Chatham.....	" "	85.27 "
Clinton.....	" "	60.00 "
Cobourg.....	" "	62.50 "
Dunnville.....	" "	60.82 "
Galt.....	" "	80.30 "
Guelph.....	" "	89.42 "
Ingersoll.....	" "	73.00 "
London.....	" "	108.58 "
Meaford.....	" "	55.00 "
Niagara Falls.....	" "	85.00 "
Owen Sound.....	" "	90.00 "
Simcoe.....	" "	73.00 "
Toronto.....	" "	108.58 "
Wallaceburg.....	" "	75.00 "
Welland.....	" "	57.20 "

A company has been organized in Peterboro to install and operate a plant for the supply of electric power. The members of the company, Messrs. W. H. Meldrum, John Carnegie and James Kendry are well known and enterprising citizens, and in their hands the undertaking should have results at once beneficial to the town in enabling it to offer to manufacturers the advantage of cheap electric power, and at the same time the returns in a financial way should be satisfactory. The power site is located at Auburn, giving a maximum transmission distance of four miles to the farthest point at which power is to be supplied. The initial installation consists of a 250 K.W. slow speed 3 phase generator of the Canadian General Electric Co's. latest type. This machine will run at the very slow speed of 200 revolutions, and will be direct coupled to the line shaft, thus saving the loss in a belt transmission. Current will be distributed at the transmission voltage, 2080 volts, directly to all the motors of more than 50 horse-power capacity. For smaller motors step down transformers will be used to reduce the pressure to 115 volts. Contracts have already been secured by the Company for some 250 or 300 horse power and it is considered likely that the installation of a second generator will be necessary in the near future. The plant is to be in operation on the 1st of January next.

The North Shore Power Company of Three Rivers, Quebec, have secured a franchise from the City of Three Rivers to supply incandescent and arc lamps as well as to pump the city water. The corporation of the City of Three Rivers installed a municipal lighting plant, but have turned it over to the North Shore Power Co., who are going to operate it with power generated on the Batiscan River at Batiscan Chute, and convey the same to Three Rivers, a distance of 16 miles. This Company have purchased from the Royal Electric Co. two of their S.K.C. 2 phase generators with a capacity of 240 K.W. each. It is the intention to generate the current at their water power, using step-up transformers, bringing the pressure up to 11,000 volts, and at Three Rivers step-down transformers will be used to reduce the pressure to a working pressure of about 1000 volts, where it will be connected to the present lighting circuits that were turned over to the North Shore Power Company by the corporation of Three Rivers. The flexibility of the system being put in by the North Shore Company is being well demonstrated by the fact that the step-down transformers are located in the old lighting station at Three Rivers, and that the present circuits for incandescent lighting will be directly connected to the step-down transformers, and that the expense in making the change in the Three Rivers station is practically nil. The transformers in use for about 3000 lights already installed are of the Royal type of 10000 alternations, and as this is also the periodicity of the 2 phase generators being installed, no change on their lines or transformers is necessary. The corporation of Three Rivers had in operation one arc dynamo of 50 lights, and one with 30 lights capacity. It is intended to drive these two arc machines with one of their single phase alternators which have been in use a number of years there, and which will be coupled in one side of the 2 phase circuit and driven as a synchronous motor.

SPARKS.

Mr. John Davidson, of Smith's Falls, Ont., has invented an electric heater.

Improvements have recently been made to the electric light station at Sherbrooke, Que.

An electric plant for lighting the town of Hull is being installed. It will be located at Deschenes Mills.

The incorporation is announced of the Amherstburg Electric Light Company, with a capital of \$20,000.

An eastern syndicate is endeavoring to secure control of the New Westminster, B. C., electric light plant.

It is rumored that a rival telephone company will shortly commence business at Halifax, but the report lacks confirmation.

Prospects are said to be favorable for the conversion at an early date of the Hamilton and Dundas Railway into an electric road.

Mrs. E. Bradley, of Lynchburg, has begun an action against the Hamilton Radial Electric Railway Co. for \$5,000 damages for the death of her son.

The Northern Electric Railway Company is applying to the Quebec legislature for incorporation, to build an electric railway from Montreal to St. Jerome.

The Ottawa Car Co. is now constructing a combined passenger, baggage and express car for the Ottawa Electric Street Railway Co. It will be 40 feet in length 13 feet longer than the ordinary passenger cars, and will have accommodation for 36 passengers and run on eight wheels.

The new exchange of the Bell Telephone Company at Winnipeg was recently opened. It is said to be one of the most complete systems in the Dominion, and was designed by Mr. J. A. Baylis, the company's expert. Prior to leaving for Montreal, Mr. Baylis and his assistants were tendered a complimentary dinner.

The Peterboro' Town Council has accepted the offer of the Peterboro' Light and Power Co. to supply the town with eighty-five 2,000 candle power arc lamps for the sum of \$65 per arc lamp per year, they to pay the sum of \$400 per year as rental for the use of the streets. The new contract is to be for the term of seven years from January 1st, 1897. Additional lamps over eighty-five are to be charged at the rate of \$60 per year.

Daniel McAuley, a young mechanical engineer of Port Morieu, C. B., has patented an invention to prevent boiler explosions. It is a steam boiler pressure indicating alarm, which is set to go off when the pressure on the boiler has reached a point over which it ought not to go, much the same as the engineer sets his alarm clock for five in the morning. If the steam valve is out of order, as often happens, no explosion can occur, because this patent will give the alarm.

Arrangements have been made for the development of the water power of the Pend d'Oreille river, in British Columbia. A power station will be located at the mouth of the river, about twelve miles from Rossland. The plan contemplates the construction of a dam, from which the water will be conducted in steel flumes and delivered to the water wheels. It is claimed that 10,000 h.p. can be developed, but it is proposed to install 2,000 h.p. to begin with. The total investment in connection with the enterprise will be in the vicinity of \$250,000.

In pursuance of a certain indenture made between the Yorkshire Guarantee and Securities Company and the Consolidated Railway Company, of Vancouver, B. C., the assets of the latter company will be offered for sale on the 17th inst. The property consists of an electric street railway extending throughout the cities of Vancouver, Victoria and New Westminster, and also between Vancouver and New Westminster, and between Victoria and the town of Esquimalt and Oak Bay, including power plants, rolling stock, etc., also lighting plants, power houses, machinery, etc., in Vancouver and Victoria.

At the annual meeting of the Acetylene Light, Heat and Power Company, held in New York during the past month, President Adams, in his address, stated that the new illuminant had been favorably reported on by both the Philadelphia Fire Underwriters' Association and the New York Board. He also presented the names of thirty fire insurance companies which had approved the use of the automatic generators. This last statement was based principally on the fact that permission had been granted a certain large risk to use acetylene, but under a number of conditions, among which was one prohibiting the storing of the carbide on

the premises. It was also required that the tank be placed outside the building.

"During his present visit to Peterboro," says the Review, "the electric light inspector of this division, Mr. Wm. Johnston, has found two electric light meters of the other kind which were being used in private houses where ten lights are generally burned but which had not registered any of the electricity passed through them for several months. The cause of this lamentable state of affairs—as viewed by the company—was apparent last night, when the inspector broke those very official looking seals which he places on every correct meter and disclosed "da niggah in da fence." Doubtless in that terrific thunderstorm in June last, when poles were struck on Macdonnell and other streets and the company's loss was counted by hundreds of dollars, some of the electricity which everybody gets gratis entered these meters and destroyed their usefulness to the company. Another case settled by Mr. Johnston was that of a local company whose manager complained that the meter they had was running too fast. The test of this meter was made in the presence of the manager and a representative of the Light and Power Co., and was found to be one per cent slow, or in favor of the consumer."

TRADE NOTES.

The Royal Electric Company are installing a lighting and power plant for the Brookfield Mining Associates at North Brookfield, N. S.

The Corporation of Huntsville purchased a 1000 light alternator of their standard single phase type from the Canadian General Electric Co.

The Royal Electric Co. have just completed the installation of an incandescent lighting plant in the large woollen mills of A. W. Brodie, Hespeler, Ont.

E. H. Thomas & Co., Norwich, Ont., are lighting their factories by electric light. The Royal Electric Co. are furnishing and installing the apparatus.

Mr. G. A. Adams, Adamsville, P. Q., has recently installed lighting plant for illuminating his mill and residence. The apparatus was supplied by the Royal Electric Company.

Wenger Bros., of Ayton, Ont., are lighting up their mills and a portion of the town by electricity; they expect to install about 200 lamps. The dynamo, etc., is being furnished by the Royal Electric Company.

Mr. J. W. Easton has severed connection with the John Abell Co., of Toronto, and connected himself with the Stevens Manufacturing Co., of London, who will in future build his latest improved electrical apparatus.

Mr. C. W. Henderson, contractor and manufacturer, has recently installed in the Canada Life new building, Montreal, electric calls in the elevators, which system is something new and very novel, being designed and manufactured expressly for that company.

The T. H. Taylor Co., Ltd., of Chatham, Ont., are lighting their large mills by electricity, and have placed their order for a 200 light dynamo with the Royal Electric Co. They are also having installed by the same firm 150 lamps throughout their mills and store house.

The Welland Vale Manufacturing Company, St. Catharines, Ont., have completed a large addition to their factory; it is being lighted throughout with electricity. There will be about 500 lamps. The plant is being furnished and installed by the Royal Electric Company.

Mr. C. W. Henderson, contractor and manufacturer of electrical supplies, Montreal, has recently fitted up some of the largest buildings in that city, notably the Montreal Street Railway Co., Montreal Diocesan Theological College, Standard Shirt Co., Thompson Shoe Co., Montreal Steam Laundry.

Mr. J. W. Skinner, of Mitchell, Ont., Canadian representative of the National Electric Mfg. Co., of Eau Claire, Wis., reports having recently made the following sales: 1000 light dynamo to the town of Goderich; 350 light plant to J. L. Eidt, to light the village of Auburn; 1000 light plant to the Kensington Furniture Co., of Goderich.

Letters patent have been issued incorporating the Paxton-Tate Company, of Port Perry, Ont., to manufacture saw mill machinery, water-wheels, etc. The capital stock is \$99,000, and the promoters are George W. Dryden, James Carnegie and William McGill, of Port Perry, Leonard Burnett, of Greenbank, Hon. John Dryden, of Toronto, and F. W. Hodson, of Guelph.

ELECTRIC RAILWAY DEPARTMENT.

AMERICAN STREET RAILWAY ASSOCIATION.

THE recent convention of the above association at St. Louis is described as having been one of the most successful in its history. The name of Mr. C. E. A. Carr, manager of the London Street Railway Co., appears in the register of attendants as the sole representative of Canada. The association declined to entertain a proposal for amalgamation with the National Electric Light Association. Captain McCulloch, vice-president and manager of one of the St. Louis street railway corporations, was elected president for the ensuing year. Niagara Falls was selected as the place of next meeting.

MONTREAL STREET RAILWAY.

THE annual meeting of the Montreal Street Railway Company was held on the 4th inst. The chair was occupied by Mr. L. J. Forget, the president of the company, and there was a good attendance of both directors and stockholders. The annual statement showed that the net earnings for the year ending September 30 last were \$1,253,183.14, as against \$1,096,911.31 for the previous year. The gross earnings were \$555,033.69. The net profits were \$462,106.79, as against \$351,349.13 in 1895. Of this amount two dividends of 4 per cent. each and a bonus of 1 per cent. were declared, amounting in all to \$360,000, the balance of \$102,106.79 being added to the surplus.

The cost of operating during the entire year was 56.48 per cent. of the entire receipts, as compared with 59.20 per cent. for the previous year.

The good results obtained from the conversion of the system to electricity are very apparent in the statistical statement. The net earnings for the year 1896 are nearly as large as the gross earnings for 1892, being \$555,033.69, as compared with \$564,406.57, and the operating expenses per cent. of earnings has fallen from 82.68 to 56.48.

The rapid growth of traffic during last winter necessitated additional power, rolling stock, etc., and an additional boiler house at the William street power station to supply steam to a new 2,500 horse power direct-connected engine and generator, was erected. Fifty open motor cars were constructed in the spring, and twenty-four closed cars are now nearing completion at the company's shops.

A resolution of condolence was passed at the death of Mr. Edward Lusher, for many years connected with the company.

The number of passengers carried in 1896 was 4,018,713 in excess of 1895. The figures for the last five years were 29,896,471 in 1896, 25,877,758 in 1895, 20,569,013 in 1894, 17,177,952 in 1893, and 11,631,386 in 1892. The transfers given last year were 8,541,530, or 28½ per each hundred passengers.

The Board of Directors was re-elected as follows: Mr. L. J. Forget, Mr. James Ross, Mr. K. W. Blackwell, Mr. G. C. Cunningham, Col. F. C. Henshaw.

It is stated to be the intention of the company to issue an additional million dollars of stock, the funds being required for extensions, improvements, etc.

ELECTRIC RAILWAY FOR QUEBEC.

AFTER negotiations extending over a long period, the construction of an electric railway for the city of Quebec seems now to be an assured fact. A meeting of the shareholders was held on the 10th ultimo for the purpose of organizing the company. A report was read by Andrew Thomson, president of the Union Bank of Canada, showing the steps which had been taken towards organizing the company, the nature of the proposed contract, and the agreement with the Montmorency Power Company for the furnishing of power. The subscribed capital was limited to \$320,000, and this amount had all been taken up. The following directors were elected: Messrs. Wm. Shaw, Andrew Thomson, John Breakey, E. E. Webb, Judge Chauveaux, H. Kennedy, E. W. Methol. On motion of the Hon. L. P. Pelletier, seconded by Mr. A. Thomson, a resolution was adopted empowering the Board of Directors to enter into a contract with the Montmorency & Charlevoix Railway Company and the Montmorency Electric Power Company for the construction of the road under the former's contract with the city, and for the supply of power by the latter. Mr. Beemer transferred his franchise to the company, but reserves the right to redeem the road up to the 1st of July, 1898, by paying interest on the capital at 6 per cent., and a commission of 10 per cent. on the amount expended by the company.

Since the meeting the four parties to the agreement for the construction of the road have signed the contract. These are, the city of Quebec, the Montmorency and Charlevoix Railway Company, the Quebec and Levis Electric Power Company, and the Quebec District Railway Company, the latter being the name under which the company will operate the road.

Large quantities of materials have already arrived for the work, and over two hundred men are employed in construction. Within a very short time the citizens of Quebec will enjoy all the advantages of a thoroughly-equipped electric railway.

CORNWALL ELECTRIC STREET RAILWAY.

THE authorities of the town of Cornwall, fully alive to the importance of rapid transit, determined to have an electric street railway, and the enterprising firm of Hooper & Starr were given the franchise. These two gentlemen are well known throughout Canada and have had a wide experience in electrical and railway work.

Ground was broken on the 21st of April of this year, and by the 24th of May 3½ miles of track were laid. There are now 5 miles of single track in operation. The handling of freight was expected to be the main source of revenue, but the passenger traffic has been greater than was anticipated, and the park, which was opened for the benefit of the patrons of the road, has proven a great attraction for the summer months.

THE ROAD BED.

The construction of the road bed was placed in charge of Mr. Bruce, C.E., who was for some time with the C. P. R. Where there was solid bottom, 9 inches of heavy boulders were laid, and on top of this were placed 4 inches of broken stone. The ties (standard) were then

laid on with earth between. A coat of macadam was afterwards placed on top, covering the rails. A heavy steam roller was then run over this, giving it a smooth, level surface. The rails are 56 lbs., with strap fish plates bonded with 0000 wire, with a malleable tapering thimble which is set in the rail. The wire is run through this and the thimble is hammered in tight. This is claimed to be a decided improvement over the soldering method.

On the portion of streets where there were sandy or boggy bottoms, cedars were laid to a width of eight or nine feet, on top of which four to five inches of macadam were laid, with ties, etc., on top. There is over a mile of this construction. Some cedars were 40 feet in length, the minimum being 16 feet. One place on their private property near the G. T. R. depot—a boggy place—was made solid by laying boards diagonally, with the boulders, crushed stone, etc., on top. Curves are laid very flat, and heavy freight cars are hauled easily round them.

Little can be said of the overhead construction, as there is no feed wire, the station being in the centre of the circuits. The trolley wire is 00 hard drawn.

ROLLING STOCK.

The cars comprise four motors, three trailers, and a locomotive, but the three trailers are being converted into motors. Two open car bodies and one closed car body, and the body of the locomotive were built by the Rathbun Company, and the balance by the Canadian General Electric Company. The locomotive is equipped with four C. G. E. 800 motors on double trucks, two motors on each truck, and weighs 15 tons. The motors are arranged on the double series system, which permits of regulating the speed according to the load. All the cars and the locomotive are mounted on steam car wheels, preventing that rocking motion incident to cars using light wheels. The trucks are made by the Canada Switch and Spring Co.

THE POWER HOUSE.

The power house is a handsome brick structure, faced with pressed brick, and designed by Mr. H. Ross Hooper, who was the architect of the car barns. It is 125 x 35 ft., divided into a dynamo and a boiler room, the dimensions of which are 75 x 35 ft. and 48 x 35 ft. respectively. The roof is supported by iron trusses.

The dynamo room is well lighted and ventilated, and the ceiling is sheathed with corrugated iron. The floor is matched hardwood, and the foundations of the machines and engines are of stone capped with brick. A 250 h.p. Robb-Armstrong cross compound engine drives a 200 k. w. C. G. E. generator. The water of the St. Lawrence is used for condensing, and a Northey condenser is in operation, with a National (Robb-Armstrong) heater. A slate switchboard is mounted with full C. G. E. equipment for the generator. The chief engineer's office and a work bench and tools occupy part of one side, and there is sufficient room for a duplicate engine and generator.

The boiler room contains two "Monarch" boilers of 150 h.p. each. The furnaces are fed with fuel of hard pea coal, mixed with the soft run of the mine. Fireproof doors separate the dynamo and boiler rooms.

THE CAR BARN.

The car barn is a frame structure, sheathed on roof and sides with metallic shingles and siding. It is 95 x 60 ft., part of which—16 x 95 ft.—is used for a freight shed.

The roof is supported by three independent trusses from a 60 foot span. The capacity of the barn is nine cars. A 30 foot repair pit is used for all repairs on trucks, motors, etc., besides a repair shop, which is in one corner. On the freight shed side are double tracks and a platform 6 ft. wide running the full length of the building. The freight is unloaded from the cars to the platform, and then into the shed.

THE ROUTES.

The system centres at the post-office on Main street, and cars meet all trains and boats. There are two lines and a spur line. One line is on the east side to the park, and the other extends from the station on west side and connects with the east side line. The spur line runs to the mills. The cars run from 5.30 a. m. to 12.30 p. m. No registers are used, the conductors being supplied with what are called shot boxes. In each box is a little shot receptacle, which will not upset as long as the conductor does not turn the fare box upside down to rifle its contents.

The park owned by the company comprises 15 acres, and is prettily situated and laid out for the enjoyment of the patrons of the road. A merry-go-round is operated by a C. G. E. 800 motor.

The directorate of the road is as follows:—President, H. Ross Hooper; vice-president and managing director, D. A. Starr; secretary-treasurer, F. M. Siddall; A. J. Hooper and W. R. Hitchcock.

LEGAL.

In the action brought by one Burns against the London Street Railway Company, to recover damages for the killing of plaintiff's dog, which ran across the track within ten or fifteen feet of an approaching car, the first Division Court of Middlesex held that the case came within *Hay v. G. W. R. W. Co.*, 37 Q. B. 465, and the action of the dog was the cause of its death, and therefore the plaintiff could not recover.

The appeal of the Toronto Railway Company from the decision of the Court of Revision confirming an assessment of \$537,137 upon their street equipment, was argued a week ago before the County Judges of York, Peel and Ontario. Messrs. B. B. Osler and Wm. Laidlaw argued the case for the Company, and the City Counsel for the city. Mr. Osler contended that the company's franchise being a limited one they stood in the relation of tenants of the city, and as such were exempt by law from taxation—the taxes being payable, except under special agreement, by the landlord. Mr. Osler advanced the further argument that the railway was a highway, the rails being part of the soil, and as such should be exempt. Counsel for the city interpreted the assessment act as placing the rails, poles and wires of the Company within the meaning of real estate, and as such liable to assessment. He quoted the words "purchaser" and "vendor" in the agreement between the Company and the city to show that the company does not stand in the relation of a tenant of the city. Judgment in the case has not yet been rendered.

The Winnipeg Street Railway Company employ for the conveyance of pic-nic and excursion parties, a motor car, attached to which are four trailers consisting of old horse cars fitted with new platforms and sills, a railing all round, and seats arranged across both sides and ends, with space for a passageway from the steps at either end. These trailers are lighted by lamps strung on wires supported on poles at either end of the car.

The Montreal Street Railway Company have recently had a system of interlocking safety devices placed at the Wellington Bridge crossing the Lachine canal. An electric motor is employed to turn the bridge. Before the bridge is opened, a derail, consisting of a tongue switch, is so set as to turn the car off the track at a distance of 80 feet from the bridge on either side, thus preventing the possibility of a plunge into the canal while the bridge is open.

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THE ONTARIO ELECTRIC AND ENGINEERING COMPANY.

As a sign of the times and increasing prosperity in the industrial world, after a season of comparative inactivity, perhaps nothing is more encouraging than to note the appearance, from time to time, of new commercial enterprises springing up in spite of the blue ruinist's cry of hard times and keen competition.

It may be that, like ourselves, the promoters of these concerns hold their own opinions as to the time when best to launch out, and no doubt they have also the conviction that after a lengthened period of depression there must always come a revival in business.

Referring more particularly to the electrical industry, we note with pleasure the arrival into the Canadian field of the Ontario Electric and Engineering Co., Ltd., recently organized for the purpose of carrying on a general electric contracting, supply and repair business, with commodious headquarters at 77 to 81 Adelaide street west.

It is intended, we understand, to pay special attention to repair work, which feature will no doubt commend itself to central station men, who even with the best of good luck may sometimes require the quick co-operation of a well-equipped machine shop and competent engineers.

The secretary-treasurer, Mr. W. Heathcote, who for

The sales department will be in the hands of Mr. J. J. Ashworth, so well and favorably known to the electrical public as having been on the agency staff of the C. G. E. Co. since its inception, having only severed his connection to identify himself with the new enterprise.

We illustrate on this page a single phase alternating current dynamo which this company are now placing on the Canadian market. It is of the inductor type, with stationary armature, and, it is claimed, combines all the qualities of durability, slow speed (that of a 60 k.w. be-



ROTOR OF WARREN DYNAMO.

ing only 720 r. p. m.), good regulation, and high efficiency. The manufacturers are the Warren Electric Co., of Chicago, Ill., for whom the Ontario Electric and Engineering Co. are acting as sole agents for Canada. Sales are reported good, although the machine has been but a very few weeks before the public.

The company are also sole agents for the Eddy Electric Manufacturing Co., of Windsor, Conn., the well known makers of direct current machinery in all sizes.

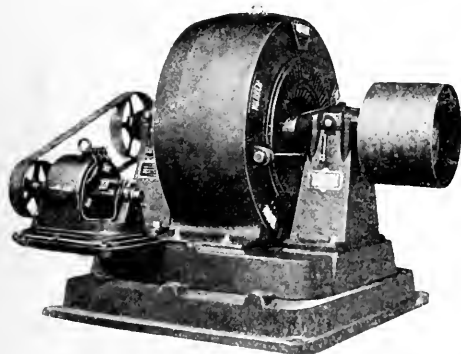
The fact of being in a position to place apparatus of such high grade on the market, and having on its executive and engineering staff, men, each a specialist in his particular line, augurs well for the success of the company.

QUESTIONS AND ANSWERS.

C. L. F., Parry Sound, Ont., writes: I enclose three pieces of wire, viz., No.'s 18 iron, 18 and 16 copper magnet, American wire gauge. Will you please tell me what size they are in B. & S. gauge?

ANSWER.—American wire gauge is the same as B. & S. Gauge. Of the three pieces of wire, the long brown one is .033 in. = B. & S. between No. 18 and 19; the very small white insulation is .005 in. = B. & S. No. 36; the short piece is .064 in. = B. & S. No. 14.

A correspondent in an Eastern Ontario city writes: "I believe that you can, better than anyone else, favor me with a definite opinion as to the outlook for college graduates in the field of electrical engineering, and from what I can judge it is the most promising of all professions at the present time, and I would like to know, with some degree of certainty, whether the field is already over supplied, as is claimed in some quarters, or whether the fault of non-success experienced by some



60 K.W. SINGLE PHASE WARREN ALTERNATOR.

some years held a responsible position on the engineering staff of the Canadian General Electric Co., Ltd., is a gentleman of sound business experience and executive ability, who will doubtless perform his duties with credit to himself and profit to the company.

The position of chief engineer is held by Mr. Hazen Ritchie, A. I. E. E., a graduate of the Royal Military College, Kingston, who has had several years' experience with the larger companies both in England and on this continent.

technically qualified men is properly attributable to their own lack of energy, or, say, want of the exercise of common sense in casting about for employment?

ANSWER.—We scarcely know what opinion to express in reply to your enquiry. We have talked this subject over a number of times with men occupying leading positions in the electrical business, and the general opinion appears to be that the outlook for young men in this calling is not as promising as a great many people appear to imagine. If you look over the electrical field at the present time you will see that the number of really good positions, in this country at least, are very limited. We know of several qualified electricians formerly occupying good positions, who, having lost them, have found it impossible to secure others equally remunerative. We do not pretend to know all the circumstances in connection with these cases, and consequently are not able to say that these persons have not, in some degree, themselves to blame for the position in which they find themselves at present. The electrical business in this country appears to be at a point where it is very difficult indeed to estimate its future development, hence the difficulty of expressing an opinion on the subject of your enquiry. If the electric railroad continues to develop as it has done during the past five years, there should be a considerable number of openings for young men in that field. This applies also to the distribution of power by electricity over long distances. If the distribution of power in this manner is found to be commercially practicable and advantageous, it will probably lead to the establishing of quite a number of large power stations at certain points throughout the country, where water power is available, and in such power stations the services of one or two first class electricians will be indispensable. With regard to the electric lighting business, a great many of the men in charge of central stations at the present time have not had proper training for the position, and are consequently lacking in efficiency. Unfortunately, the owners of stations do not appear to realize, as they should, the necessity of employing properly qualified men and paying them satisfactory salaries. Until the owners of stations come to realize that a poorly qualified superintendent is dear at any price, there will be few openings in this direction for the services of properly qualified young men. We are not without hope, however, that the business will ultimately be placed on a proper footing and will be conducted more in accordance with the best known principles of business management. When that time arrives the number of openings for competent young men will be increased. This is the situation as it presents itself to us at the present time. What new developments in the use of electricity may be forthcoming in the near future it is impossible to know.

POWER DEVELOPMENT AT NIAGARA FALLS.

By F. C. ARMSTRONG.

THE delivery in Buffalo on the 15th of November last, of the first thousand horse power out of eight thousand which the Cataract Construction Company are under contract to supply to the Buffalo Railway Co., marks the completion of an important stage in this notable enterprise. No undertaking in recent years has attracted the attention of the engineering and industrial world to so great a degree as the now accomplished "harnessing of Niagara"; and no undertaking of a certainty has had to win its way to a signal success in the face of greater difficulties and more discouraging and persistent prophecies of failure. Although so much has been written from time to time during the progress of the work that the

electrical public, at any rate, are pretty well conversant with its history, a brief recital of its main points may not be out of place at the present moment.

From the day when Father Hennepin in his *Nouvelle Decouverte* first published to the world a description and sketch of the mighty cataract, the Falls of Niagara have held their place as the great natural wonder of America, the main objective point on this continent of the globe trotter and the wedding tourist. It was not to be expected, of course, that the utilitarian spirit of recent years would be satisfied to find scenery alone in what was plainly meant for water power. Some early attempts at utilization were made, and the present Niagara Falls Hydraulic and Land Company is a development from the first hydraulic canal constructed between 1853 and 1861. In both Canada and the United States, however, a strong and wide-spread feeling existed against any further disfigurement of the naturally charming surroundings of the Falls which culminated in the nationalization for park purposes of the lands enclosing them on both sides.

In 1889 the Cataract Construction Company was organized to carry out the plans for power development worked out by Thomas Evershed. These embraced mainly the taking of the necessary water supply from the river by a short canal at a point one-and-one-half miles above the Falls, its delivery at this point, where the erection of the necessary buildings would not be objectionable from an æsthetic standpoint, into a wheel-pit 178 feet in depth, and its discharge through an underground tunnel into the river at a point directly below the upper Suspension Bridge, the capacity of the tunnel being fixed at 120,000 horse power. The personnel of the company, of which Mr. E. D. Adams was president, Mr. W. B. Rankine secretary, and Messrs. D. O. Mills, J. Pierrepont Morgan, W. K. Vanderbilt and J. J. Astor, members of the Board of Directors, was a sufficient guarantee that the capital necessary for an undertaking of such magnitude would be readily forthcoming.

As general consulting engineer the company retained Dr. Coleman Sellers, the hydraulic and electrical portions of the work being placed respectively in the hands of Mr. Clemens Herschel and Professor George Forbes, of London, England.

In 1893 the International Niagara Commission, composed of Sir William Thomson (Lord Kelvin), Dr. Sellers, Col. Theodore Turrettini, Professor Mascart and Professor William Unwin, were invited to examine existing methods and select plans for the detail apparatus required in the development and transmission of the power. For the turbines the design submitted by M. M. Faesch & Piccard, of Geneva, Switzerland, was selected. For the transmission, as might have been expected, electricity was finally adopted, though not without a careful examination into the merits of compressed air, hydraulic tubes and rope transmission.

Regarding the position taken by Lord Kelvin, Prof. Rowland and other authorities consulted, toward the particular electrical system and type of generator ultimately used, a somewhat acrimonious discussion has since been carried on. It seems fairly clear, however, that to Professor Forbes is due the credit of insisting on the employment of alternating instead of direct currents—a choice of which no one would to-day gainsay the wisdom in view of the different uses requiring widely varying voltages for which the current is now being required. A second point on which Professor Forbes was exposed to attack was his advocacy of a comparatively low frequency. Here again the advantage obtained of greatly lessened inductive loss on the long distance transmission lines, added to the much greater suitability of the low periodicity for rotary transformer work, has been amply sufficient to demonstrate the correctness of his judgment. The umbrella shaped type of generator adopted, with an external revolving field and stationary armature, which has proved itself admirably suited for the requirements of a large fly-wheel effect and light revolving weight, is substantially the design submitted by him as consulting engineer to the manufacturing companies. In this connection it may be added that whatever estimate is to be placed on Professor Forbes' work for the Cataract Company, he is certainly entitled to respect for the courage with which he has always been ready to defend his convictions. The Partisan dart which he discharged at his critics and detractors in his famous article in "Blackwoods," affords sufficient evidence on this point.

The first of the three five thousand horse-power generators forming the original order given to the Westinghouse Electric Manufacturing Company, was started up on the 5th of April, 1895, and shortly afterwards the regular supply of current to the amount of 2,000 h. p. to the Pittsburgh Reduction Company for the manu-

facture of aluminum was commenced. To the electro-chemical group of local users of the new power there has since been added the Carborundum Company, which produces in the electric furnace, from carbon, in one of its many metamorphic conditions, an abrasive claimed to be superior to emery.

A preliminary installation for the manufacture of carbide of calcium uses at present 1,000 horse-power. This amount will undoubtedly be greatly increased should acetylene gas in the future become something less of an ignis fatuus and more of a practical illuminant. Other local applications of the power are, with synchronous motors, to operate the generating plant of the Niagara Falls Electric Light Co., and with rotary transformers in supplying current at 500 volts for the Buffalo & Niagara Falls Railway.

It is as marking the satisfactory commencement of the second stage in the distribution of the power in which its successful transmission over considerable distances is the problem to be worked out, that the thousand horse-power already laid down in Buffalo becomes of the first importance. The difficulties to be overcome are not, of course, of an engineering nature, since several transmissions on a large scale over greater distances have been for some time in operation. The question has been whether electric power generated under the conditions which obtain in the Cataract Company's plant can be sold at a profit in Buffalo at prices as low as those at which steam power can be produced under the absolutely favorable conditions existing at that point. Comparative estimates made by the most capable engineers have differed regarding this all-important matter to a curious extent. The result, as indicated by the contract entered into with the Buffalo Railway Company for 8,000 horse-power delivered, at a price stated to be \$36.00 per horse-power per annum, would seem to show that the Cataract Company's officials and one of the most important of their prospective customers, have been able to arrive at a mutually satisfactory basis of price for the transmitted electric power where the circumstances governing its previous production by steam were such as to render possible the very highest economy.

It seems reasonable to estimate the amount of power which will be disposed of in Buffalo within a year at not less than 15,000 horse-power, and in view of this and other increasing demands, an additional order has been placed with the manufacturers for five 5,000 horse-power generators, which will bring the total generating capacity of the plant up to 40,000 horse-power. For the transmission to Buffalo, which has been carried on under the plans of the General Electric Company, a line potential of 11,000 volts is now being used, but this will be doubled to 22,000 volts later on, in order to keep the copper cost and energy loss within reasonable commercial limits. The three-phase system is used for the transmission instead of the two-phase, on account of the very considerable saving effected in copper. At the substation in Buffalo the current stepped down to 2,000 volts is carried through underground cables to the Railway Company's power house, where, after further stepping-down, the General Electric Company's rotary converters change it from an alternating to a direct current at the standard railway voltage.

The commercial success, now practically assured, of the transmission to Buffalo, entails of course the extension of the company's field of operations in this direction over a wide area. Just where the commercial limitations which will govern in the matter will fix the point beyond which Niagara power cannot be profitably delivered, would be at this moment a very unsafe matter on which to hazard a definite opinion. It should be kept in mind, however, that the completed scheme of the Cataract Company involves the development of 200,000 horse-power on the American and 250,000 horse-power on the Canadian side of the Falls, to find a market for which will require a transmission radius considerably in excess of 100 miles.

The other important power development already referred to—the Niagara Falls Hydraulic and Land Company—will, along with various projects now under consideration on the Canadian side, be more fully considered in a subsequent paper.

The Minister of Education has promised to provide for the sustenance of the Toronto Technical School in case the city provides a permanent building therefor.

The Metropolitan Street Railway Company have extended their line to Richmond Hill, and are considering the further extension of the line to Lake Simcoe, in which case a new power house will probably be erected at Newmarket or Aurora. The present power house near Mount Pleasant will be improved.

TRADE NOTES.

The Canadian General Electric Co. are supplying a 1,000-light standard single phase alternator to Victoriaville, P. Q.

A large engine for the St. Thomas Electric Light Works was recently supplied by Cowan & Company, of Galt, Ont.

The Ontario Electric and Engineering Co., Toronto, have sold a 500-light alternating plant for lighting the town of Newcastle, Ont.

The Canadian General Electric Co. have been awarded a contract for a 500-light incandescent plant for the town of Alvinston, Ont.

P. McIntosh & Sons, of Toronto, have installed in their factory a 300-light incandescent plant supplied by the Canadian General Electric Co.

The Almonte Electric Light Co. have added to their plant a 600-light incandescent generator manufactured by the Canadian General Electric Co.

The Canadian General Electric Co. are installing a 500-light single phase standard alternating plant for a local company recently organized in Embro, Ont.

The Toronto office of the J. C. McLaren Belting Company, of Montreal, has been removed to 69 Bay street. Craig, McArthur & Co. are the representatives in this city.

Messrs. Coristine & Co., of Montreal, have installed a 35 k. w. direct current incandescent generator of the Canadian General Electric Co.'s moderate speed multipolar type.

The Canadian General Electric Co. have closed a contract with the Canada Paper Co. for a 1,000-light incandescent generator of their latest multipolar steel type, with iron-clad armature.

The Electric Repair and Contracting Co., of Montreal, are at present busily engaged in rebuilding motors and generators damaged by fire which took place recently on the premises of the Montreal Park & Island Railway Co.

The St. Catharines Electric Light & Power Co. have placed an order for a 2,000-light standard single phase alternator with the Canadian General Electric Co. The 60 k. w. machine of the same type which they have been operating up to the present has proved insufficient in capacity to meet the growing demands of their business.

The Fraserville Co., Ltd., of which Mr. John MacFarlane, of the Canada Paper Co., Montreal, is president, are installing a complete 750-light alternating plant in the town of Fraserville, Que. The entire contract has been awarded to the Ontario Electric & Engineering Co., Ltd., who will install for the generating plant one of their 45 k. w. single phase "Warren" alternators.

The Berlin & Waterloo Railway Co. have just placed in service two new vestibuled cars, having a length over all of 27 feet 6 inches. These cars are exceedingly handsome in design and finish, solid mahogany being used throughout for the interior fittings, and embody important improvements in various details. They were constructed at the Peterboro shops of the Canadian General Electric Co.

Owing to the rapidly increasing demand for their goods, the Kay Electrical Mfg. Co., of Hamilton and Toronto, will shortly commence the building of an addition to their factory. The following is a partial list of their more recent sales: Kemp Mfg. Co., Toronto, 2 motors; H. R. Cuddon, St. Catharines, 1 motor; M. Hutchinson, wood yard, Toronto, 1 motor; A. Moore, Toronto, 1 motor; Aylmer Electro Plating Co., 1 dynamo; Steel Clad Bath & Metal Co., Toronto, 1 4-pole motor; Wheeler Brush Co., Toronto, 1 motor; Leitch & Turnbull, Hamilton, 3 motors, for elevator purposes; A. R. Williams, Toronto, 3 motors; Davis & Henderson, Toronto, 2 motors; Mr. Garner, Toronto, 1 motor; Mr. Enright, Toronto, 1 motor; Mr. Bomberg, Toronto, 1 motor dynamo; H. C. Hunter, Dundas, 1 4-pole 400-amp. dynamo; Haskins Wine Co., Hamilton, 1 motor; McPherson & Glasco, Hamilton, 1 motor; Munderloh & Co., Montreal, 1 dynamo; J. Turner & Son, Toronto, 1 motor; Wm. Reers, Toronto, 1 motor; T. Bell & Co., wood yard, Toronto, 1 motor; Barber Bros., Georgetown, 1 30-h. p. 4-pole motor; H. & F. Hoerr, Toronto, 1 motor, 15 h. p.; Ontario Agricultural College, Guelph, plant for light and power; Small & Fisher, Woodstock, N. B., 1 dynamo; A. Laidlaw, Toronto, 1 motor; Mr. L. Williams, Toronto, 1 motor; John Forman, Montreal, 3 motors; Wilson Pub. Co., Toronto, lighting plant; T. E. Brandon, Toronto, 1 motor; Davison & Holmes, Toronto, 1 motor; Bennett & Wright, Toronto, 2 4-pole motors; Diamond Machine & Tool Co., Toronto, 1 electro plating dynamo. This firm have also sent to electric machines to the North-west and British Columbia.

THE YOUNG MAN'S CHANCES IN THE ELECTRICAL FIELD.

IN view of the opinion which seems largely to prevail that electricity is the thing to which young men should now turn their attention with the best hope of reaping satisfactory results from their labors, the editor of the *ELECTRICAL NEWS* deemed it advisable to solicit opinions on the subject. For this purpose the following letter was recently addressed to a few persons prominently identified with the electrical interests:

DEAR SIR, To assist me in answering frequent enquiries as to the possibilities for qualified young men in the various departments of electrical work, I have thought it advisable to endeavor to obtain an expression of opinion from a number of persons qualified to advise on the subject.

The enquiry may be briefly put thus:—"What are the chances of the young man who graduates as an Electrical Engineer in comparison with the young man who enters any of the other professions or commercial life?" I would esteem it a favor if you would kindly give me an expression of your views on this matter in time for publication in the *ELECTRICAL NEWS* for December.

C. H. MORTIMER.

We trust the appended replies will be of assistance to parents and young men who find themselves face to face with the problem of choosing in what direction life's efforts should be expended:

Mr. Granville C. Cunningham, manager and chief engineer of the Montreal Street Railway Company, writes:—"At present there seems to be more opening in electrical engineering than in any other professions in this country. Of course the success of a man largely depends upon himself. There is little doubt, I think, but that electricity, during the coming years, will have large developments in this country."

The manager of another important electrical company, who requests that his name be omitted, writes:—"Replying to enquiry contained in yours of 28th inst., it is common knowledge that every profession, trade, and calling is overcrowded, but that there is room at the top for persons of exceptional ability, is well known, and any person of even more than average ability will succeed fairly well whether he be on a farm, in commerce, or in professional life. What then are the chances of a young man of more than average ability who graduates as an electrical engineer, in comparison with those of a young man of equal ability who enters one of the other professions, say law or medicine? Let us see how the matter stands in Toronto. There are in round figures 500 lawyers. We will not be far out in saying that the number who possess more than average ability and who have established a practice is about 150, and these have incomes of \$1,000 a year and upwards. Are there ten electrical engineers in Toronto earning this amount?"

"There are lawyers in Canada making eight and ten thousand dollars per year and some as high as fifteen and twenty thousand. How many electrical engineers in the country are making half of the lowest figure?"

"What is true in law holds equally so in medicine. There are about 400 doctors in Toronto, and judging by the houses they inhabit and the style of their living, the average income of an established doctor of more than average ability must at least be as great as that of his legal brother.

"The man of less than average ability has neither room nor place in any profession. He may graduate as an electrical engineer, but will end up in attending a dynamo or stringing wire at forty or fifty dollars a month. The time spent at college would have been better employed in getting a practical mechanical education or a sound business training.

"I have no desire to discourage persons from going into a business employing electricity. The prospects of a bright intelligent young man would be at least as good as they would be in any non-electric business, but I feel that our schools and colleges are turning out a hundred electrical engineers for every vacant position in the country. What is to become of them? Electricity does not spell any royal road to fortune."

Mr. Wm. H. Browne, general manager of the Royal Electric Co., Montreal, writes:—"In reply to your enquiry as to what are the chances as an electrical engineer, compared with other professions or commercial life, I presume the answer would be that on the average the electrical engineer would be likely to do as well as the average man in other professions or commercial life.

"In electrical work, as in all other work, the most room is at the top, but it is quite likely that for some time to come the electrical engineer who can be at the top may not be as financially successful as his corresponding member of the legal or medical profession or the commercial man.

"The field for opportunity for clients is necessarily, at present, much more restricted in the electrical line than in the other professions or commercial life, because the industry is new, but there is no doubt that the growth of the electrical industry, by reason of the increase of the application of electric power, will very largely increase, and within a few years will require the talents of the best members of the profession, and those who may be capable of meeting these requirements will, no doubt, do as well as the best members of other professions.

"In my judgment, one of the greatest needs of the electrical business of this country to-day is the employment in all operating electrical plants, of thoroughly well qualified young men, graduated as electrical engineers.

"I have frequent applications in our business here, from parents of young boys, sixteen to eighteen years of age, to take them into our shops and teach them the electrical business.

"The impression appears to prevail, that this is all that is necessary to make competent electrical engineers.

"I am obliged to refuse all such applications and advise such parents that if their sons have special aptitude and inclination for mechanics, that they be sent to some good college to receive a thorough complete course in electrical and mechanical engineering, for the two are almost necessarily bound together, and after graduation, to seek occupation practically, either in the operation of an electrical plant or in a manufacturing establishment.

"The electrical engineer requires special qualifications to fit him for his profession and there have been many who have graduated as such who have probably made a grave mistake, by reason of not possessing the special aptitude and talents."

Prof. Galbraith, Principal of the School of Practical Science, Toronto, writes:—"Your question is not an easy one to answer. It seems to me that it is well to assume that all money-making occupations, businesses and professions are full. This being the case, success will depend largely on the special fitness of the candidate for his chosen vocation. Natural capacity for one's work, supplemented by education and training ought, other things being equal, to ensure a reasonable amount

of success. There is always room at the top; to get there, however, requires special qualifications as well as opportunities. The man who takes an interest in his work for its own sake and not simply for the money which he may make from it, will not be discouraged by hard times, and will in all probability work his way through life more cheerfully than the man who values his occupation simply by the dollars and cents he may make out of it. A young man ought not to select his profession simply because at present business in it is good, nor ought he to reject a profession for the opposite reason. He ought to remember that his choice is not only for the immediate future, but for life, and that during his life ups and downs may be many and not far between."

Mr. G. J. H., manager of an Electric Light and Power Co., writes: "Complying with your request of the 28th November, will say that your enquiry covers quite a lengthy opinion.

"The comparison between a young man graduating as an electrical engineer with a man entering a commercial life, can be made as follows: The man entering a college course to qualify for an electrical engineer has before him, I think, a four years course. He enters at the age of 18, and say he gets plucked two years out of his course, which would bring him to the age of 24 when he qualified, he then really has to make a start in life, or in other words hang out his shingle that he is ready for business, unless he happens to be fortunate enough to secure a position with some reliable firm. If not, he may plod along for a couple of years, very often receiving smaller wages than the ordinary mechanic who has served his time at the bench. In this connection there comes to mind the cases of two personal friends of mine; the first graduated as an electrical engineer from McGill about a year and a half ago; he went to one of the largest cities in the States, and at the present time is drawing the heavy salary of \$1.50 a day. The other, now out of college some time, secured the appointment of Construction Superintendent on an electric road, and after giving the company the benefit of his college education as an electrical engineer in overcoming technical difficulties and systematizing the whole road, was politely dismissed, to be replaced by a man that could never know as much as this engineer had forgotten, but it was a question of a few dollars a year in salary. As a rule you will find that college graduates expect to start their professional career at very large salaries. This is one of the greatest mistakes these graduates could make. When it comes to closing an engagement they prefer to hold off for several months, than close at a fair salary. As a consequence you will find college graduates filling commercial positions, for which purpose their college education is of very little use, to say nothing of the four to six years of their life that has been to all commercial purposes lost. I do not refer particularly to electrical graduates, as I could record several similar instances as applied to civil engineers. As you are well aware college education can never do a young man any harm, provided he can afford to take a course and spend the required time.

"As a rule a young man starting a commercial life would be about 15 years old, and would have from 15 to 24 to make a mark for himself, the ability to do which must naturally depend largely on himself. Provided he starts with a reliable firm, displays any ability,

or is at all industrious, he is almost certain to secure advancement, and in time, no doubt, will be given a position of trust, and by the time his friend had graduated at 24, the commercial man would have better prospects than the graduate.

"This is the age of development in electricity, and I think if I had a boy of 15 or 17 I would prepare him to take a course to qualify as an electrical engineer, but as we all know there are so many different opinions on the bringing up of boys, that it is a matter that would take hours of discussion."

Mr. E. Carl Breithaupt, Consulting Electrical Engineer, Berlin, Ont., writes: "Replying to your enquiry of the 28th ult., as to the relative chances of a young man who graduates as an electrical engineer as compared with one who enters any other profession or commercial life, it seems to me that such a comparison is not altogether a proper one to make; a man must have a very particular fitness to make a success in any profession, and especially do I think this is the case in the three Engineering professions, the Civil, Mechanical and Electrical. If a boy shows aptitude and fondness for engineering work, is willing to work very diligently, and willing to don a suit of overalls and perform heavy manual labor at any time he may be called upon, either day or night, I think his chances as an electrical engineer are as good as those of any other calling in life. There is one thing, however, that must be remembered, viz., that very few engineers in any one of the three branches named have become very wealthy in the practice of their profession. Engineering work must be considered more as a labor of love than one for financial gain."

Messrs. Ahearn & Soper, Ottawa, write: "Replying to your favor of the 28th ultimo, asking what are the chances of the young man who graduates as an electrical engineer in comparison with the young man who enters any of the other professions or commercial life, we think his chances are now about equal. A few years ago his opportunity for obtaining employment might have been better, but electrical engineering today, like other professions, seems to have been overdone."

Mr. George White Fraser, Consulting Electrical Engineer, writes: "In answer to your enquiry of date 30th, now as to the prospects of young men entering the electrical engineering profession in Canada, I would say: At the present moment there is practically no electrical engineering in Canada. When persons are contemplating an enterprise involving the use of electricity for lighting, power or railway purposes, the last man they think of consulting is an electrical specialist. This is due apparently to the fact that, first, the general public seem to think that they know enough about it to do without advice; second, the manufacturing companies naturally do all they can to discourage the idea of consulting competent engineers in independent practice, and offer to do all engineering themselves free of charge. The general public accept this seemingly generous offer, shutting their eyes to the rather obvious consideration that this engineering has got to be paid for somehow, whether done by an independent person, or one employed by a manufacturing company, and that the engineering of the latter is necessarily biased in favor of the "system" exploited by his company; third, there have been no competent electrical engineers doing business until quite recently the only persons in that

line having been more entitled to the name of 'electrical mechanics' than of 'electrical engineers' being able merely to make repairs and do small wiring jobs. Of course we have many instances of civil, hydraulic and mechanical engineers, and architects, and even land surveyors, who, without the slightest right to do so, have called themselves electrical engineers, and freely advertise their specialties as being electric railways, electric lighting, etc., and actually get work in those lines which they simply hand over bodily to the manufacturing company of their choice; and fourth, that a great deal of such electrical work as there has been, has been more or less of a pettifoggish character municipal deals, small lighting plants, and so on. I think, however, that a different notion is taking hold of the public, that is rather encouraging to the independent engineer. In the first place, happily, these small plants are about all sold now, and people are getting a little less confident as to their electrical attainments. The evolution of machinery from the old D. C. or single phase alternating type to the latest polyphase development, with all the latest storage battery, inductor type, direct connected side issues, has rather brought electrical engineering, as such, to the front; and as the public begin to read a little more, and hear a little more, and find out that electricity is not "in its infancy," nor yet a matter of unspeakable mystery, but a science to be studied and understood; a profession clearly distinct from civil or mechanical, or hydraulic engineering, and vastly different to architectural or land surveying, so do they think more of obtaining advice from electrical men more especially as the number and variety of different types of machinery offered to them increase to their great perplexity.

"Briefly—I think that most of the small work is done. During the next several years large works will be promoted large railways, power schemes, electrolytic plants, etc.; the men interested in them are business men who will not submit to the dictation of any manufacturing company, but retain outside independent engineers, knowing very well that electrical specialists can attain better results than the most experienced general practitioner. Therefore I think there is plenty work to do for electrical engineers who will vigorously insist on recognition, who will keep themselves absolutely free of the influence of any manufacturing company and who will keep themselves abreast of the times. It will be a hard fight, for we have many antagonists—we have the inertia of an ignorant public, the animosity of powerful manufacturing companies, who, in my own experience, will go to any length to persuade customers against calling in independent advice; and we have the jealousy of the other branches of the great engineering profession, who do not care to see electricity defined as a specialty for which they are not professionally qualified. I, personally, shall be glad to welcome any accession to the ranks of the independent electrical engineering profession in Canada, and think that success is a matter of determined effort and co-operation."

Mr. C. E. A. Carr, manager of the London Street Railway Co., writes: "In reply to your inquiry of the 28th November, I should think the chances of success in the electrical field were much better than in any other, for the reason that the uses of electricity are daily becoming broader, which is not the case, in so marked a degree, in any other profession."

Mr. R. A. Ross, mechanical and electrical consulting engineer, Montreal, writes: "Replying to your enquiry as to what are the chances of young men who graduate as electrical engineers in comparison with those who enter the other professions or commercial life, I should say, that without doubt at the present time electrical engineering is overcrowded, and will probably always remain so for the following reasons:

"To a new profession there is always a rush, and in this case the influx has been particularly large, because of the rapid expansion of electrical enterprise, necessitating a large amount of engineering supervision, which has become unnecessary as the enterprise settles down to a rigidly economical basis.

"Again, civil engineering has long been recognized

as an overcrowded profession, and the tendency of those contemplating entering the engineering field has been to avoid the civil and enter the new and rapidly expanding electrical field. This result has obtained in spite of the fact that although there is room for a civil engineer or two in every county, there is not room for an electrical engineer in a dozen counties. Further, electrical engineering will always attract to itself more than its legitimate share of students because of its novel attractiveness, and will tend to remain crowded. A glance at the list of students now entered in electrical engineering at our colleges will give eloquent testimony to above opinions."

Mr. James Milne, Lecturer in Electricity, Toronto Technical School, writes: "The great trouble in these days, I think, is in giving the young man the impression that if he receives a university training and graduates as an electrical engineer, that his services will be in demand, and that he will be looked up to by every one in the business, while the man who has been less fortunate as regards his education, but serves an apprenticeship to some trade, will be inferior in every respect."

"I believe in giving a fair education to all, but after that education has been attained the best thing that can be done is to learn a trade, and in learning that trade care should be exercised in the selection of the proper place."

"A young man who serves his apprenticeship in a small place, that is in a place where there is a scarcity of tools, etc., will in most cases turn out a better workman than the one who serves his time in a very large concern. In the smaller place ingenuity has to be exercised to get the various jobs done with the tools that are at hand, while in the large place special tools are ready made for almost everything. Therefore, in this respect the proper place to serve an apprenticeship is where a turn at everything may be got, such as pattern-making, fitting, turning, armature winding, etc., etc., and finishing up with the drawing office. This is what a complete apprenticeship should comprise. In these large manufacturing concerns where premiums are paid for instruction, the chances of knowing something at the end of the time are very slim indeed. There is one good thing about the arrangement, however—the money is generally thrown away by those who can afford it, and benefits the electrical concern, but whether or not it benefits the other party is a secondary consideration."

"In the smaller place the young man gets a fair insight into everything, and gets accustomed to the use of tools, and by and by is sent out to do various jobs and gain valuable knowledge and experience, and in a comparatively short time becomes a first-class practical man."

"Our learned brother, the electrical engineer, who has just graduated, finds that before he can be of much use he must gain practical knowledge, and to do this he has to get into some shop. Now here is where the sticker is; he has been led to believe that he will not have to soil his hands, and that his brains will do it all. He never made a greater mistake in all his life."

"For some unknown reasons, parties in charge of shops or branches of any manufacturing concern will almost invariably refuse to employ these graduates, even although their services are offered gratis, and it is right here where our premium system comes in. They pay the money for instruction, and simply put in the necessary time, and that is about the end of it."

"Our man who has served his apprenticeship in the small concern and spent his spare time in reading up, sees an advertisement which reads something after the following: 'Wanted—a good man to take charge of an electric light plant—apply at so and so.' He, of course, applies, and in his application he states his experience, etc., together with all the rest of his redeeming qualities. For the situation we have 100 applications, 99 of which are from electrical engineers, graduates of some university. The parties to whom the applications have been sent read all the applications and comparing all their good points decide to give the situation to our practical man. This, I think, is pretty nearly the universal experience."

"When we bear in mind that what might be termed 'good jobs' are very scarce, and in Canada there

probably are about a dozen of them, which at present are all filled, the chances of an opening are very slim indeed, unless by some unforeseen calamity, such as a death, and the chances of our electrical engineer dying are probably about the same.

"There can be no doubt, however, that exceptionally smart men, no matter what profession be it electrical, mechanical or otherwise will make their mark, but this does not mean that our fortune favored electrical engineer will in very many cases knock out our man with the more practical ideas.

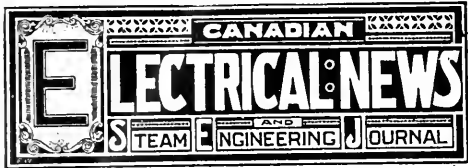
"It appears to me that if this education business is forced much higher than premiums will soon have to be offered for ordinary working men. If some manufacturing concern were to start up, say in the electrical business, and several foremen were required, I know I am correct when I state that every foreman would be selected from the ranks of those who have graduated (?) in the shop, and should it happen that say a superintendent or engineer was required to supervise the whole engineering part, you will find that the man appointed will be also a thoroughly practical man, with, however, a good technical education.

"To finish up with, I would like to state that if any young man is an aspirant for some fine job—nothing to do and big money for it—let him keep out of the electrical business, and more especially the lighting and power part of it. Without exception it is the most aggravating, most tantalizing and thankless of all, and an eternal source of worry from early morn to late at night, which accounts for those in this part of the business being old men long before their time."

Mr. J. J. Wright, manager Toronto Electric Light Co., writes: "At the risk of being considered somewhat of a pessimist, I am compelled to take a view of the question that I am afraid will not suit the sanguine enthusiast who considers that 'electricity is only in its infancy' and that there are unbounded possibilities in the business for those who study electricity. The difficulty is that the field—in Canada, at least—is extremely limited. There are perhaps a dozen positions in the entire Dominion that it would pay the enterprising young electrical engineer to aspire to, and, unlike a mercantile business or the profession of physician or lawyer, they are not likely to materially increase. For instance, in each large city we have one street railway company and one, or at most, two, electric light companies. As these cities increase in size and population they will require, or rather, there will be room for, more lawyers and more doctors to maintain the present ratio, but when they are twice the size there will be but the one street railway and the one electric light company—if, indeed, these have not amalgamated and still further reduced the meagre opportunities. In the mercantile business or the legal or medical profession, or in the many branches of trade or commerce, an enterprising young man who has gained the requisite knowledge and saved a few dollars may enter and may hold his own with the best, and there is something lacking if he does not make a mark. At any rate, he has an equal chance with the rest to reach the top of the tree. But, no matter how smart he is as an electrician, if he feels the irksomeness and limitation of a subordinate position, he cannot start an electric light company or a street railway company of his own—at least, not often, and if he waits for the manager, or the superintendent, or the electrician of his local company to die or to hang himself, he has at least the satisfaction of knowing that the chance of survival is about equal, if indeed he does not starve to death in the meanwhile. There are but two manufacturing concerns in the country of any size who make a specialty of electrical apparatus. Let us say that one or two more come into existence. They have each their staff of 'electricians,' who supervise the construction and installation of apparatus, and these concerns are already capable of considerable increase in their output without any further skilled help as 'electrical engineers.' As electrical installations increase, as no doubt they will, especially in railway work, it follows that the increase in men employed will consist of the rank and file of intelligent mechanics and laborers, whose functions will consist simply in handling the apparatus put in

their hands—mechanics who will be perfectly competent to repair and operate the machinery, and laborers, firemen and oilers, whose wages will run from a dollar to two and a half dollars a day. The 'electrical engineer' does not appear to come in at all. When I mention lawyers and doctors I do so, not that I advise a young man to take up these professions because they are admittedly overcrowded—but as an illustration; simply to show that in similar professions there are opportunities for the clever man to rise to the top if he has the qualifications; whereas it matters not how great the qualifications if there are no opportunities or openings for their exercise. As a matter of fact, most of the professions appear to be overcrowded. The mistake of parents generally arises from their desire to see their sons do better than they themselves have at least in appearance, and to have them rise in the social scale. The money they are expending in over-educating their boys for a struggle in an unremunerative profession has been made by every-day plain and prosaic hard work, but work that has borne excellent fruit. There is many a farm acquired in this way that to-day is mortgaged to the hilt to pay for the university education of a boy who was considered too good for his surroundings and who was not satisfied with plain honest work like his father did, though that work would have brought him independence and comfort instead of the worry and strife that is necessary even to wrest a moderate living in the midst of the fierce competition of professional life. I believe that if a tithe of the same training and ability, method and scientific knowledge required for this were applied to the operations of the farm, that the results in wealth, comfort and happiness would far transcend the best that can be gleaned in the care-strewn paths of professional life.

"I am afraid I am making this letter somewhat long, and getting a little off the track of the 'Electrical Engineer,' but holding the position I do, and being brought into contact as I am every day with many who have the idea that electricity is the coming thing and who want to learn electricity with a view of being as it were 'in the swim,' I cannot refrain from giving expression to my views. In one of your articles in the November issue of your paper you voice the complaint of an electrical man who kicks about this very thing. Because the country plant wants only a skilled laborer to look after its meagre apparatus, and cannot afford a school-taught electrician with a stand-up collar, he considers it a grievance. The fact is that the lot of the electrical operator is not a happy one, and not nearly as desirable as the ordinary observer who sees no further than the outside glamour is apt to think it is. The farm-laborer has a picnic in comparison. If he has to rise at day dawn, at any rate he gets his sleep at night—night with the electrical man is his time of greatest tension. There is no let up Sunday or week day, holidays as well; life, as Mr. Mantalini would say, is 'one deuced horrid grind.' The running of a high tension station is a hot, dirty, and to some extent, dangerous job, and the most of the work is done while the rest of the world are enjoying their relaxation from toil. Competition with other methods of lighting compel the station manager to exercise the most rigid economy. Therefore his work is subdivided and specialized. It is a 'one man one job' business. He wants a man to do one thing AND TO STAY AT IT. Therefore the young man who wants to learn the whole of it stands little chance. A modern electrical installation cannot be a training school or there would be an end of efficiency. It is often a matter of wonder to me what is to become of the comparatively large number of graduates in electricity and electrical engineering that are yearly turned out from our educational institutions. There will undoubtedly be a few who will drop into positions that will from time to time be available. More who will be compelled to work with the rank and file whose numbers can be recruited equally well from our Schools of Science, or from the grease pot and wiping rag, but the majority will be compelled to remain in a state of 'innocuous desuetude' and vegetate upon the wealth of their parents till some other career opens out to them."



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. John Fox, President; Chas. Moseley Vice-President; T. Eversfield, Recording Secretary, University Crescent.
MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month in Engineers' Hall, Craig street. President, John Murphy; 1st Vice-President, J. E. Huntington; 2nd Vice-President, Wm. Smyth; Secretary, B. Archibald York; Treasurer, Peter McNaughton.

ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. K. Drouin, President; Alfred Le Tour, Secretary, 306 Deltelieet, St. Cuneoindre.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Macabee's Hall. Wm. Norris, President; E. Teeter, Vice-President; Jos. Ironside, Corresponding Secretary, Markland St.

STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. J. B. Forsyth, President; Jos. Ogle, Vice-President; T. Pilgrim, Continental Cordage Co., Secretary.

LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. G. E. Risler, President; D. Campbell, Vice-President; Wm. Meaden, Secretary-Treasurer, 533 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p. m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month in Hamilton's hall, Rideau street; Frank Robert, President; F. Merrill, Secretary, 352 Wellington street.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. J. R. Uley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p. m. President, F. Simmons; Vice-President, J. W. Tandin; Secretary, A. Macdonald.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKillop's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

WIARTON BRANCH NO. 13.—President, Wm. Craddock; Rec.-Secretary, Ed. Dunham.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outwaite, President; W. Forster, Vice-President; A. E. McCullum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening. President, Archibald Franklin; Vice-President, John Grundy; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

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Information regarding examinations will be furnished on application to any member of the Board.

CENTRAL stations are regarded as very poor risks, generally, by the fire insurance companies; and no wonder. In very many cases an electric lighting business is undertaken as collateral to a planing or saw mill, and the building containing the electrical machinery is added in the form of a small shed, to the mill. The leads from the machine to the outside lines are looped about anywhere, and very inefficient precautions are taken against bad grounds on the machine or switchboard. Now conditions that increase the fire risk, are very favorable for expensive leaks and wastes of current, so that any precautions taken to lessen the risk are of double benefit as tending to lower the operating costs as well. Insurance people are apt to be very cautious and conservative when dealing with electricity, and often impose conditions that seem to be unnecessarily strict; but then they are in a position to more or less dictate terms; and as a matter of fact, the method of making installations in smaller towns is apt to be very lax.

Polyphase Electric Railways.

THE application of alternating currents to street railway purposes has long been a problem that now seems to be in a fair way of being solved. The advantages of high voltage transmission are too obvious to require any mention, and would be of special importance in the development of many country railway systems, the length of whose routes, however, would necessitate a very large expenditure for feeder copper on the usual 500 volt system, apart from the complication introduced by the double trolleys and overhead work required by any polyphase motor when used for traction purposes. The fact that induction motors, as now constructed, are built for only one efficient speed has been regarded as an insuperable obstacle to their use on cars. This,

however, is not so very serious a difficulty after all, for on country routes where stops are infrequent, and at certain definite places only, it is not required to vary the speed, except, of course, on starting, and perhaps on very sharp curves and crossings of roads. This condition has actually been met in practice, by the expedient of so constructing the motor as that certain poles can be cut in or out, thus causing the rotor to travel at a less or a greater angular speed. Rumors are current of satisfactory results having been reached by experimenters in this field; and we may reasonably expect within the next very few years to have polyphase railways running with commercial success.

The Steam Plant in Central Stations.

We have lately presented in our columns, a paper on the subject of steam engine indicators and the advantages to be derived from their frequent use. The steam part of an electric power house is one that receives but little attention very often from the owners of such plants, and their ill success is due, in great part, to this laxity. We have lately had occasion to critically examine indicator cards taken from a number of engines of different makes that have been continuously in use for a number of years, and if all our readers had the same opportunity of seeing the results as we have, we believe the use of the indicator would be much more frequent than it is. There seems to be an opinion among the smaller steam users, that once an engine has been put in—there is an end of it. They conclude that iron and steel last for ever; that there is no wear and tear; and that if the engine is properly oiled up by a \$1.00 a day mechanic, it requires no further attention. We desire to most emphatically protest against this idea, and urge our readers to keep a constant watch over the performance of their engines. Valves will inevitably wear, pistons have an unfortunate habit of abrading, and the result is some inefficiency of steam use that consumes more fuel than would otherwise be necessary. There is no more useful—we might say essential—instrument in a power house than an indicator, nor is there one that is more seldom found. An intelligent man with an indicator and voltmeter and ammeter can, in the course of a month, learn more about the economical generation of electricity, and the manufacture of dividends, than a whole year of study in mathematical works for which his technical education is not sufficient.

Improved Methods. It is exceedingly interesting to observe the growth of electrical enterprises in Canada during the last few months.

Not only is this evident in the number of new enterprises inaugurated, but in their varied character; and more especially in the fact that considerably more attention is being paid to the preliminary engineering than used to be the case. It seems to be more generally recognized that electric lighting is a business by itself, and deserves careful attention as such. The "survival of the fittest" principle has also been exemplified in the fact that there really seems to be less poor machinery on the market, and more satisfactory apparatus. The purchasing public are becoming more awake to the fact that machinery should not be selected on the basis of its price only, but also in consideration of its inherent electrical and mechanical excellence, and that there is sufficient difference between good and poor machinery, to more than

counterbalance a considerable difference in first cost. We have also observed that there is a greater variety in the types of machines—both steam and electrical—purchased than used to be; and the reason for this seems to be that purchasers are beginning to rely less on their own ideas as to what is best, and to advise with independent authorities. The first result of this course has been that a better all-round class of construction has been undertaken; and the second that purchasers have not been limited to one or two makes of machine, but have felt less hesitation in purchasing in the open market.

CONCENTRATION and improvement are the most marked evidences of electrical progress. Within the last few months

many electrical companies have been making great steps in those directions, and, we are glad to learn, always with satisfactory results. It is very interesting and instructive to note the particular lines along which such new dispositions seem to be principally made, and their perfect similarity should give good forethought to electrical men who desire to keep their places in the front rank of intelligent operators. Investigation into the operating economies seems to have had a large influence in suggesting changes; first, in an entire reconstruction of distributing systems, lines and transformers; next, in the substitution of a few large generating units of modern make, for many small units of a type which, although representing the best that could be made some years ago, has been proved wanting. Next we have observed an encouraging tendency to build new power houses and to pay considerable attention to their designing for convenience and efficiency; and lastly, and we think, best of all, there is an increasing demand for a better educated and more capable class of operator. We take some credit for having in a measure influenced this improvement. During the past eighteen months we have repeatedly called attention, both editorially and through papers by competent authorities, to the many important subjects for investigation by enterprising electrical men. It would be greatly to the interest of the whole electrical generating industry, if they could arrange to tackle central station problems as an association instead of as individuals. The suggestion has been made that there might with advantage be established under competent direction, a central station laboratory, in which accurate tests could be made of the quality of lamps, transformers, carbons, wire and electrical supplies of all kinds. We would be glad to have opinions on this subject.

PERSONAL.

Mr. A. S. Colpitt has been appointed city electrician for Halifax, N. S.

Mr. A. E. Edkins, Registrar of the O. A. S. E., has recently returned from a trip to England.

Hon. Louis Tourville, who was largely interested in the Tourville Electric Light Co., of Louisville, Que., died in Montreal early in November.

On the 25th of November, Mr. Adam Rutherford, secretary-treasurer of the Hamilton, Grimsby and Beamsville Railway, was married at Grimsby to Miss Marie Nelles, of that town. Rev. C. R. Lee officiated.

It is stated that Mr. Romaine Callender has gone to England to commence a telegraphic business between that country, France, Germany, etc., and the United States. Mr. Callender is said to have invented a new system of telegraphy, making it possible to turn out over half a million words in less than 28 seconds.

SOME ELECTRICAL INDUSTRIES OF ST. CATHARINES.

SITUATED on the old Welland canal, the city of St. Catharines is provided with a water power such as few cities in Ontario can boast of. Each lock is harnessed to furnish power to some industry, and flumes run in all directions to convey the water to turn the wheels of commerce. In electrical enterprises the city occupies a prominent position, having a first-class electric street railway, lighting station, and a number of other electrical industries. The street railway is known as the

PORT DALHOUSIE, ST. CATHARINES AND THOROLD ELECTRIC STREET RAILWAY.

Although not yet reaching Port Dalhousie, its extension to that point is now under way. It performs the functions of a freight and passenger service, the freight being carried by flat cars. The line extends from St. Catharines to Thorold, passing through Merriton. A branch also runs to the cemetery outside of St. Catharines.

Fifteen years ago Dr. T. S. Oille (now president of the Niagara Central Railway) organized a company to operate a horse car railway between St. Catharines and Thorold. This was operated successfully until 1887 when Mr. E. E. Smith gained control of the road, and converted it into the first electrical road in Canada. It was of the Van Depoele system, the trolley travelling on top of double trolley wires, and being connected to car by a flexible rubber covered cable.

During the past spring the road was converted into an up-to-date electrical railway, under the supervision of the present owners, Messrs. Dawson & Symmes, who are practical electricians. The conversion of the road from the old Van Depoele system to the modern equipment has placed St. Catharines alongside of her sister cities.

The machines in the power house were overhauled and a new C. G. E. generator added. A new electric water governor of Mr. Symmes' design does admirable service, as the route is so hilly and tortuous that a governor is indispensable.

The track, eight miles in length, is single, and is laid with 56 and 66 pound rails. The overhead construction is No. 0 trolley wire and 000 feed wire. There are no rigid brackets.

The rolling stock consists of eight Patterson & Corbin cars. Three are closed and three open motor cars, the other two being trailers. The motor cars are equipped by the Canadian General Electric Co.

The offices and barns are on the main street of the city. The barns are well equipped with tools, by means of which the company are enabled to make nearly all their repairs.

Like many other street railway companies, a park is controlled by the company. It consists of six acres, well situated and nicely wooded.

The road has improved wonderfully under the management of Messrs. Dawson & Symmes, and is one of the best equipped in the province.

ST. CATHARINES ELECTRIC COMPANY.

The city is supplied with electric light by the St. Catharines Electric Company, the superintendent of which is Mr. McNaugh, who has a wide experience in electrical matters. Over a thousand incandescent lights are in use, also 75 arcs, 62 on the streets and 10 in business houses, three being used for lighting the plant itself.

The plant is situated on the old canal, a considerable distance from any other buildings, thus lessening the fire risk. It is in charge of Mr. Chas. Steel, who has been with the company for many years.

A heavy head of water operates two water wheels of 135 h.p. and 100 h.p. respectively. These wheels each turn a shaft 30 feet in length and five inches in diameter. One shaft drives the C. G. E. 1000 light alternator and exciter and a Minneapolis water wheel governor, while the other drives the three 35 light Royal arc machines. The current of the alternator is controlled from a skeleton C. G. E. switch-board, with its complement of instruments, etc. On the wall near the arc machines are the arc instruments, complete with lightning arrestors, etc.

Over the wheel room, which is in the annex, is the repair shop and lamp testing room, well supplied with requisites.

One interesting feature noticed was an alarm bell, which is rung by the person approaching the front door. As he approaches within a few feet of the door he necessarily steps on the platform, underneath which are metallic plates which come in contact and form a circuit on which is a bell in the dynamo room.

COOK & SONS' ELECTRIC POWER PLANT.

Within the last few years, the use of electric motors for operating small plants has become so important that the above named firm, who owned a valuable water site and building on the old canal, decided to put in a generator. The head of water of 12 feet turns two Little Giant turbines of 96 h.p. each, which together operate a shaft 30 feet long by 4½ inches in diameter, on which is a fly-wheel 7 feet in diameter. A belt from this fly-wheel drives a 100 K. W. C. G. E. generator. The current is directed by a frame switch-board, on which are C. G. E. instruments, except a direct reading Weston volt meter. The instruments consist of an ammeter, a circuit breaker, a volt meter, a rheostat, and two lightning arresters. The wheels are controlled by a hand regulator, which is a greater economizer than an electric governor, as the latter uses up too much current for a small machine. Over twenty-five patrons are supplied with power from motors of from 1½ K.W. to 24 K. W. The noted street car builders, Messrs. Patterson & Corbin, use a 12 K. W. motor, and Cook & Son use a large motor in their planing mill.

Messrs. Cook & Son intend catering for lighting patronage, and a 1000 light alternator will be in operation at an early date.

THOROLD ELECTRIC LIGHT COMPANY.

The suburban town of Thorold, connected by the street railway, is lighted by the Thorold Electric Light Co., whose plant is also located on the old canal. From an 11 feet head two wheels are turned, one a Little Giant and one a Leffel of 60 h. p. each, which in turn operate a 25 foot shaft. From this shaft are driven a 600 light C. G. E. alternator and exciter and two 25 Ball arc machines. A C. G. E. skeleton switch-board with its full equipment of C. G. E. instruments is connected to the alternator. To the Royal arc machines are connected Ball arc instruments, which are fastened on the wall.

Below the dynamo room in the basement are the wheel pits, and down there Mr. Jas. McGill, jr., the electrician, has a dark room where he finishes his photographs, for Mr. McGill is an enthusiastic

amateur photographer. In the rear of the dynamo room is a well equipped repair shop. In this shop are piled, ready for shipment, boxes of Mr. McGill's patent wire connector, which was described in the columns of this journal some months ago.

The proprietors of the plant are Messrs. John McGill, sr., and John Battle, the latter being also the proprietor of the Thorold Cement Works. Their business has been quite successful, and larger machines may shortly be put in.

Prominent among the other electrical concerns of St. Catharines may be mentioned the Packard Electric Co., Patterson & Corbin, and T. L. Wilson's acetylene gas works, descriptions of which will probably be given in a future issue.

THE ALLISTON MILLING COMPANY.

The above company some time ago secured control of the Alliston flour mills, in which was located the electric lighting plant. Finding that the dust arising from the manufacture of the flour had a bad effect on the successful working of the electrical machines, they decided to build a separate building for the electric plant. This building is a red brick cottage structure, 32 x 40 feet. It is divided into three parts, one for the boiler, one for the engine, and one for the dynamos. Through the wall next the mill runs a shaft, which, when water is high, can run both the mill and the dynamos, or when the water is low the engine can run both the mill and the dynamo.

In the mill are two Little Giant water wheels, one of 25 h.p. and the other of 40 h.p. These wheels can be connected to the 12 foot shaft entering into the dynamo room when required.

In the boiler room is an 80 h.p. Osborne-Killey boiler, supplying steam to a 75 h.p. Osborne-Killey engine. The engine and a hot water heater occupy one room. The water goes to the boiler at 205 Fahrenheit. A plunger pump is connected to the fly wheel.

The machines in the dynamo room are, first, a 500 light C. G. E. alternator with exciter, 700 lamps being installed throughout the town; second, a Reliance arc machine of thirty-five lights capacity, twenty-two of which are in use—eleven commercial and eleven on the streets. On the C. G. E. skeleton switch-board are the instruments of both machines.

The dynamo room is lighted by an arc light, and the other two rooms and the mill by incandescent lights.

It is probable that waterworks machinery will be placed under the building, which, if installed, will necessitate an addition to the building.

RECENT CANADIAN PATENTS.

Mr. Ferdinand de Camp, of Berlin, Germany, has been granted a patent, No. 53,449, for a furnace and apparatus for burning coal dust, which consists of the combination with a coal dust feeding device of a fan so arranged as to propel the coal dust together with air into the furnace, and a rotary shifting cylinder to uniformly distribute the same, also of an arrangement which closes the issue of the coal dust hopper in such a manner that the coal dust taken up by the conical portion of the worm from the hopper is conveyed to the cylindrical enlarged portion in a loose condition for further conveyance.

A patent has been granted to Joseph Hardill, Benson French, and R. T. Harding, all of Stratford, Ont., for a steam engine, with cylinder provided with two pistons and rods, and a suitably operated valve whereby steam is directed against the outer ends of faces of the pistons to force them inwardly, and at the end of the inward stroke is admitted into the cylinder between the pistons to force them outwardly.

It is claimed to consist of a combination of the cylinder, the piston and piston heads having movement therein, the steam chest, elongated parts connecting the central portion of the chest to the cylinder, the valve provided with double ports designed to co-act with a central port and elongated ports, the exhaust port in the valve designed to connect with the central port, etc.

The Bell Telephone Company, of Montreal, have been granted a patent, No. 53,605, for a telephone key-board, also for a keyboard apparatus for telephone switchboards.

A patent for converting simple into polyphase alternating circuits has been granted to Charles S. Bradley, of Avon, N. Y. It consists in the combination with a simple alternating current circuit, of a plurality of transformers supplied thereby, means for creating a difference of phase in the several transformers, and interconnections for combining the displaced phases to produce a resultant phase, and a plurality of coils in inductive relation to the several phases, said coils being connected in series relation.

The longest commercial distance at which the long-distance telephone is now operated is from Boston to St. Louis, a distance of 1,400 miles. The line is almost twice as long as any European telephone line.

It is reported that the construction of the Huron and Ontario Electric Railway is to be commenced at once. The road will extend from Kincardine and Goderich via Walkerton to Eugenia, the junction town, thence north to Meaford and south to Port Perry. A meeting of the provisional directors will be held in a few days to ratify the agreement with the contractor.



THE ALLISTON MILLING COMPANY'S BUILDING.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE. Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

ANNUAL DINNER OF TORONTO NO. 1.

The annual dinners of Toronto Association No. 1 have become to be looked forward to by the members and their friends with much anticipation and interest, and each year their growing popularity is shown by an increase in attendance. This year it was the tenth annual banquet, and was held on Thanksgiving eve. The scene of the festive gathering was the Palmer House, and the spacious dining-room afforded ample accommodation for the guests, who numbered about 200. The tables permitted of all being comfortably seated at one time, which was a marked improvement over former years. The ten large electric light chandeliers, each decorated with four union jacks, presented an attractive appearance. The arrangements were complete and well carried out.

The duties of Chairman devolved upon Mr. John Fox, President of the Association. To his right were Mr. John Yule, President of the Canadian Electrical Association, Mr. E. H. Keating, City Engineer, Ald. McMurrich, and Prof. Galbraith, Principal of the School of Practical Science. On his left were Dr. Orr and Past-Presidents Wickens and Lewis.

The visitors from outside places were Messrs. R. C. Pettigrew, Treasurer of the Executive Committee, and R. Mackie, Treasurer of the Ontario Association, both of Hamilton; G. M. Hazlett, President of Winnipeg No. 11, and W. L. Oathwaite, President of Peterboro' No. 14.

The Chairman read letters of regret from the following persons: Messrs. R. J. Fleming, Mayor of Toronto; O. P. St. John, President Marine Engineers' Association; A. Ames, President Ontario Association; James Devlin, President Executive Council; John Galt, C. E., Mechanical Engineer; and J. C. Robb, of the Boiler Inspection and Insurance Company.

The supper provided was of excellent quality, and such as would satisfy the appetites of the most ravenous. The menu was as follows:

MENU

OYSTERS.

New York Counts (Raw au Lemon).

SOUP.

Cream of Oyster.

FISH.

Boiled Sea Salmon, Hollandaise Sauce. Hors d'Oeuvres. Pomme de Terre.
Parisienne. Celery. Pickled Beets. Red Cabbage.

BOILED.

Sugar Cured Ham, with Spinach. Leg Southdown Mutton, Caper Sauce.

ROASTS.

Sirloin Beef, Yorkshire Pudding. Young Turkey, Stuffed, Cranberry Sauce.
Spring Duck, Apple Sauce. Haunch Venison, Red Currant Jelly.

COLD MEATS.

Tongue. Pigs Feet. Lambs' Tongues. Head Cheese.

VEGETABLES.

Tomatoes. Green Peas. Boiled and Mashed Potatoes.

SALADS.

Chicken. Celery. Behemian.

PUDDINGS.

English Plum, Brandy Sauce. Baked Cocoanut, à la Creme.

PASTRY.

Apple. Mince. Lemon.

DESSERT.

Charlotte Russe. Lemon Sponge.

JELLIES.

Champagne. Strawberry. Sherry Wine.

FRUIT.

Florida Oranges. Bananas. Snow Apples.

Green Tea.

Black Tea. French Coffee.
Crackers and Cheese.

Shortly after ten o'clock, after an hour or so had been spent in disposing of the viands, the Chairman addressed a few words of welcome to the guests, and proposed the toast of "The Queen," which was responded to by the singing of the National Anthem.

After a song by Mr. Grant, Mr. A. M. Wickens was called upon to respond to the toast, "Canada, Our Home." He referred to the large number of men of stability to be found in Canada, who, he said, were proud to call themselves Canadians wherever they went. He hoped that, instead of having five million people in Canada, we would shortly have twenty millions.

Ald. McMurrich, in the absence of the Mayor, acknowledged the toast of the city of Toronto. He came to the city over 52 years ago and had enjoyed every day since. He was interested in the success of the Stationary Engineers, and fully recognized the benefits to be derived from such an association. Their positions were among the most responsible which any person could occupy.

A song by Mr. Blackgrove was followed by the toast, "The Manufacturers," coupled with which were the names of Mr. John Main, of the Polson Company, and Mr. Weeks, of the Weeks-Eldred Company. Each spoke of the kindly feeling which existed between the manufacturers and the engineers. Mr. Main thought the prospects for the coming season were promising, and hoped soon to observe the return of good times.

A song by Ald. McMurrich was well received, after which the toast of the "Educational Interests" was proposed by the Chairman, to which Prof. Galbraith, of the School of Practical Science, and Dr. Orr, of the Technical School, responded.

Prof. Galbraith was pleased with the success of the Engineers' Association. It had begun in a small way, and for a time was not particularly prosperous, but was now assured of success. He stated that of late much attention had been given to the relative merits of low speed and high speed engines, but the problem had as yet never been satisfactorily settled. Electricians were now making engines half way between high speed and low speed. He referred to the recent experiments of Dr. Jakes, of Boston, who had endeavored to produce electricity by means of ordinary combustion, doing away with both the steam engine and the boiler. He stated that the experiments were not considered successful. In his opinion the only hopeful way by which the steam engine could be done away with in operating electrical machinery was by the use of the steam turbine, which was as yet only in its infancy. Late developments along this line strengthened this conviction, and so far had met with a moderate degree of success. By this method the steam from the boilers was blown into a turbine, thereby causing the turbine to revolve. He could not understand how it would be possible to do away with the boilers also. In his closing remarks he stated that we required a little more imagination among our technical teachers. We had always looked up too much to other countries.

Mr. Charles Palmer then voluntarily favored the company with a song of his own composition, entitled, "My Own Irish Love," which received a very hearty encore, as did also his response.

Dr. Orr was called upon, and spoke especially in regard to the Toronto Technical School, which, he said, had been an unprecedented success. In five years the number of pupils in attendance had grown from 246 to

1310. This in itself proved conclusively that the educational system of Ontario had not met the requirements of the country. Mechanics must be educated in this country as well as elsewhere. Germany had superseded England in manufacturing industries as the result of her thorough technical schools, and he believed we should have primary technical schools in every manufacturing centre in Ontario. He was pleased to learn that it was proposed to introduce manual training in our public schools. At present our children were educated only for one course—a non-productive course, and no one could make a good mechanic without a thorough knowledge of mathematics. The Toronto Technical School had of late been the subject of much adverse criticism, of which he thought it was entirely undeserving. Taking the statistics in connection with education in Toronto, it was shown that 34,000 pupils were attending the public schools, 1,300 the High schools, and 1,310 the Technical School. The cost per pupil in the public schools was \$19, in the High schools \$31, and in the Technical School \$6. He thought this clearly showed that the money given to the Technical School was well and profitably spent. This school, he said, had been established largely as the result of efforts on the part of members of the Canadian Association of Stationary Engineers, in conjunction with Mr. John Galt, C. E. He wished the Association continued success.

A song by Mr. Ferrier followed.

The names of Mr. E. J. Philip, Vice-President, and Mr. R. C. Pettigrew, Treasurer, were coupled with the toast of "The Executive." Mr. Philip said that the Executive had brought up many new schemes, and were extending the field of the association. Two new branches had been started during the year. He hoped that they would shortly succeed in obtaining a license law, which he considered an absolute necessity. A thorough engineer required as much knowledge as any other profession, yet they had no law. There were plants in Toronto where hundreds of people were working above the boilers, which were in charge of incompetent and unreliable men. Their efforts to secure legislation had been defeated in the Ontario House, and now they proposed to endeavor to get an act through the Dominion Parliament.

Mr. Pettigrew referred briefly to the advantages to be gained by employing a licensed engineer.

A song by Mr. Blackgrove, entitled "Remember You Have Children of Your Own," was much appreciated.

The next toast was "Sister Societies."

The first speaker was Mr. John Yule, President of the Canadian Electrical Association. He congratulated the engineers upon the apparent success of their association, and thought their object was a worthy one and deserving of support.

A recitation was given by Mr. Post, and Mr. George Mills, President of the Brotherhood of Locomotive Engineers, spoke on behalf of that organization, which, he said, had been in existence for 33 years. It was first started in Rochester with twelve men, but now had a membership of 35,000. They had a Legislative Board both for Ontario and the Dominion, of which he was chairman.

Mr. A. E. Edkins represented the Ontario Association of Stationary Engineers, which, he said, was the outcome of the labors of the Canadian Association. Four

years ago a Board of Examiners was appointed to issue certificates, and he had just had the pleasure the previous evening of issuing the 650th certificate. Much credit was due the association for raising the standard of steam engineering over what it was fifteen years ago. Many engineers had been better fitted to fill their positions by the efforts put forth to qualify themselves to pass the examinations. During his visit to England he had been struck with the technical schools there, and had the pleasure of visiting the Birmingham Technical and Art School. In their efforts to secure legislation, he said the engineers should receive the support of steam users, and pointed to the advantages which would accrue. The English law did not require an engineer to hold a certificate, but steam users were compelled to employ a competent person and to have their plants inspected once a year. The owner is held responsible for any accident, and is therefore interested in preventing the same.

At this stage Dr. Orr proposed the toast of Toronto No. 1, to which Mr. James Huggett and Mr. Wickens responded. Mr. Huggett referred to educational matters and to the new library which had been commenced, while Mr. Wickens, in showing the advantages to be derived from the association, pointed out that many engineers had been thus enabled to double their salaries in a few years.

After a response to the toast, "Visiting Brethren," by Mr. Robert Mackie, of Hamilton, another song was rendered by Mr. Grant.

Mr. Hazlett, of Winnipeg, was also called upon. He stated that in Winnipeg they had a law relating to the inspection of boilers, and had tried to get a bill passed licensing engineers.

The hearty reception given to the toast of Mr. Fox, President of Toronto No. 1, was acknowledged in a few well-chosen remarks, and after "The Press" had been duly honored, and responded to on behalf of the Canadian Engineer and the ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL, the singing of "God Save the Queen" closed the evening's programme.

To the committee in charge of the arrangements is largely due the success of the banquet. Messrs. Thos. Eversfield, G. C. Mooring, A. M. Wickens, John Fox, J. Marr and J. Bain were the members thereof. Mr. R. G. Stapells presided at the piano.

TORONTO NO. 1.

At the regular meeting of the above association, held on Wednesday, the 2nd inst., one candidate was initiated. After the transaction of routine business, Bro. E. J. Philip gave the first of a number of short talks on "Natural Philosophy," which was greatly appreciated, and for which he received a hearty vote of thanks from the members. Another talk will be given at the next regular meeting, at which it is hoped a large attendance will be present.

LONDON NO. 5.

Our association met on the 10th ultimo and re-organized, with the following members as officers: G. B. Risler, Advertiser office, president; D. Campbell, Pottersburg, vice-president; W. Meaden, secretary-treasurer, re-elected; Duncan McKinley, recording secretary; Wm. McLean, guard. It was decided at the meeting to permit engineers to join before the first of January next at a lower rate. Some consideration was given

to the Scranton Correspondence School. Our meetings are held on the first and third Thursdays in each month in Sherwood Hall.

D. McKINLEY, Rec.-Secretary,
292 Ridout street.

HAMILTON NO. 2.

At the last regular meeting a paper on "Heat," which will be found printed in this number of the NEWS, was read by Mr. James Gill, B. A., of the Collegiate Institute. As the result of an interview by the officers of the association with the School Board, that body has agreed to stipulate that in future engineers in steam heated schools must hold at least a 3rd class certificate. Quite a number of new members have been received into the association recently.

JOSEPH IRONSIDE, Secretary.

KINGSTON NO. 10.

At the last meeting of Kingston Branch No. 10, it was decided (by a standing vote of the members present) to change the meeting nights from the 1st and 3rd Tuesdays to the 1st and 3rd Thursdays of each month, the next meeting night occurring on Thursday evening, December 3rd, 1896.

Very truly yours,

JOHN McDONALD, Secretary.
98 Clergy Street.

BROCKVILLE NO. 15.

SIR, - Since our last report we have removed to new rooms more suitable for our association. When any of our brother engineers come to Brockville they will find our rooms on the second storey of Richard's Block, on King St. The attendance at the meetings is good and one new member has been initiated.

JAS. AIKINS, Recording Secretary.

PRESENT STATUS OF THE DISTRIBUTION AND TRANSMISSION OF ELECTRICAL ENERGY.

Mr. Louis Duncan, President of the American Institute of Electrical Engineers, concludes a paper on the above subject, with the following summary of conclusions :-

My conclusions, subject always to the influence of local conditions, are as follows :

1. In both direct-current lighting and traction systems, where the power is generated in or near the area of distribution, it is best to use one station situated at the most economical point for producing power.
2. In the case of the traction systems, when the economical area of direct distribution is passed, boosters should be employed directly or in connection with batteries, to a distance of 10 or 12 miles from a station, and beyond this rotary transformers, whether with or without batteries, should be used.
3. In the case of direct-current lighting systems, the energy should be transmitted to storage batteries situated at centres of consumption either directly or by means of a rotary transformer and distributed from them.
4. Where batteries are used, it is best to place them at the end of feeder wires to obtain the advantage of a constant load on the wire.
5. The best system for the long-distance transmission of energy, for general purposes, is the three-phase alternating system.

6. Commercial transmissions are in successful operation for distances of 35 miles and for voltages as high as 15,000 volts.

Experience with these plants shows that the transmission to 50 miles, with a pressure of 20,000 volts, is practicable ; beyond these limits the transmission would be more or less experimental.

MR. O. E. GRANBERG,

DISTRICT DEPUTY FOR QUEBEC, C. A. S. E.

In the portrait appearing below is presented the countenance of Mr. O. E. Granberg, District Deputy for Quebec for the Canadian Association of Stationary Engineers. Mr. Granberg was born in Norway, Europe, in 1852, and came to Canada in 1860. At 12 years of age he entered a blacksmith shop, where he remained for three years, and later served three years in a machine shop. After working some time in the foundry and pattern shops, he went to New York and worked for some years in different engine and boiler works, returning to Canada in 1875. He was then employed in erecting engines, boilers and machinery in



MR. O. E. GRANBERG,
District Deputy for Quebec C.A.S.E.

mines, and shalting, gearing and machinery in manufacturing establishments. After having fitted up machinery in a cotton mill, he was employed as chief engineer and master mechanic for some years, and was subsequently made manager of the mill. He gave up that position for the one he now occupies, that of Inspector of the Boiler Inspection and Insurance Company of Canada, which he has occupied for over six years.

Mr. Granberg holds first-class engineers' papers, and is a qualified and authorized boiler inspector and examiner of engineers and firemen, as per Industrial Establishment Act of the Province of Quebec. He received the appointment of Examiner of Boiler Inspectors from the Lieutenant-Governor of the Province of Quebec in 1894, and has been a member of the Canadian Association of Stationary Engineers for five years, in which organization he is very popular.

WORDS OF APPRECIATION FROM THE FAR NORTH.

MR. E. B. Congdon, Fort Macleod, N. W. T., in renewing his subscription to the ELECTRICAL NEWS, writes: "I enjoy the paper so much that I would not like to have it discontinued."

HEAT.*

By JAMES GILL, B. A.

It was with some diffidence that we agreed to read this paper before you, knowing, as we do, that you are all practical men and that our knowledge for the most part is but theoretical. However, we will go on the assumption that most teachers take, that you know nothing about the subject.

Our first question with regard to heat is, what is it? In past time it was considered a material substance that entered into a body, and by its presence there rendered the body warmer; its absence left the body cold. There was this difficulty, however, in supposing heat to be a material substance, in that the body when warm weighed no more than when cold. Sir Humphrey Davy melted two blocks of ice by rubbing them together, and concluded that heat was not a material substance, but a form of motion. Heat is generally understood at the present time to be due to the motion of the molecules of a body. These molecules are in constant motion, and when their motion is quickened the body becomes warmer; when their motion is retarded the body becomes colder.

In the next place let us inquire into the ways of producing heat. We will place down six ways of obtaining heat:

1st. From MECHANICAL ACTION as shown in friction. You are all acquainted with the result of rubbing a button of brass on your coat-sleeve. It used to be a common trick with school boys to rub the button for some time and then place it on the back of a playmate's hand. It had about the same effect as the sun's rays through a lens. Also the Savage of the Isles of the Sea was accustomed to produce fire by rubbing two dry sticks together.

2nd. PERCUSSION—As shown in placing a piece of lead on an anvil and hammering it. It soon becomes quite hot. The lead bullet after striking the metal target is too hot to pick up.

3rd. COMPRESSION—As shown in placing a piece of tinder in a tube in which a tube moves up and down. The mere shoving of the piston downwards is enough to ignite the tinder.

4th. CHEMICAL ACTION—Wherever chemical action goes on heat results. Pour some sulphuric acid into a vessel of water and then place your hand against the outside, you will find that the vessel is warm. Again the heat in the human body is maintained by chemical action.

5th. HEAT FROM THE ELECTRIC CURRENT.—If you take several cells and connect for battery purposes, and then hold in your hand the two terminals from the positive and negative poles, you will soon find them too hot to hold. You have no doubt heard of a whole meal being cooked in Ottawa by means of heat obtained from the current.

6th. RADIANT HEAT—As obtained from the sun. The sun radiates heat on all sides, and this is borne to us through the ether which is supposed to fill all space.

The first three of these classes may be placed under the one head of "mechanical action."

Then let us notice the effects of heat applied:

1st. EXPANSION—As shown in a bar of metal placed rigidly between two fixed supports and heated. The bar bends and twists out of the straight.

2nd. CHANGE OF STATE—As shown in a block of ice to which heat is applied. It is first converted into water, and then if sufficient heat be applied, into steam.

3rd. CHANGE OF TEMPERATURE—Which we measure by means of the common thermometer.

We would like you to notice here the difference between temperature and quantity of heat. A cup of water and a pailful of water may be at the same temperature, but the pailful has the greater quantity of heat because it has the greater amount of mass. Again, we would notice that there is always present a tendency to equalization of temperatures. This takes place in three ways:

1st. RADIATION.—If I light a fire in the stove here it soon makes itself felt throughout the room, by radiating heat in all directions.

2nd. CONDUCTION.—Place in the fire one end of an iron bar and it will not be long before you are unwilling to keep hold of the other end. This is due to the molecules of the bar conducting the heat from the end in the fire to the end held in the hand.

3rd. CONVECTION.—This is the warming of a room or house by the bodily movement of a heated substance, such as is shown in the warming of buildings by hot air. The air is heated at the furnace and moves bodily from there to the rooms of the building.

Physicists are in the habit of using certain units in which to ex-

press amount of heat. One of these units is the amount of heat needed to raise one pound of water through one degree Fahrenheit. By means of these units a relation between heat and work can be expressed. First a definition of work: If one pound of matter be raised vertically against gravity through one foot, one foot-pound of work is said to be done, or if a body be drawn through one foot against a resistance from friction of one pound, one foot pound of work is said to be done. It is found from careful experiments that one of the above heat units is equivalent to 772 foot pounds of work. You are also acquainted with the unit used in expressing rate of doing work, viz., the horse power. One horse power is equivalent to 33,000 foot pounds of work per minute.

Just here we might give the method of finding the horse power of an engine: Find the area of the piston head in square inches and multiply by the length of stroke doubled and by the number of revolutions per minute, and also by the pressure in lbs., which product divide by 33,000, and the answer is in horse power. Thus, if effective pressure of steam be 60 lbs., diameter of piston 14 inches, length of stroke 2½ feet, and revolutions 70 per minute, then the horse power of engine will equal

$$\frac{(14 \times 14 \times .7854) \times (2\frac{1}{2} \times 2) \times 70 \times 60}{33,000}$$

But the all important point with the engineer is the conversion of heat into work. Where heat is applied to water it confers upon the steam which is produced the power of doing work, such as driving the piston from one end of the cylinder to the other against resistance. For example, the heat energy of the boiler in the engine is transferred into mechanical motion. The steam is admitted to the cylinder, and by means of its expansive force drives the piston to the other end, then by a special movement of slide valves caused by the eccentrics, the steam is allowed in at the other end of cylinder and the piston moves in the other direction, and so the motion is maintained. Work is done by the steam during its admission into the cylinder, and also by expansion after its admission.

Steam in its expansion obeys the well known law of Boyle, viz., that if the temperature be kept constant the volume of a given body of gas varies inversely as pressure, density and elastic force. If the steam be allowed to enter at full pressure of 80 lbs. for say one fourth the stroke, and is then cut off, the piston will have to be forced to the other end by the steam working expansively.

What is known as back pressure must be taken into consideration in finding the work done. The back pressure is usually fifteen pounds to the square inch in a non-condensing engine, so that the steam in cylinder must not be allowed to expand so far as to bring its pressure down to that amount. The relation between pressure and volume in a given body of gas may be very easily shown to the eye by a graphic representation by taking horizontal lines to represent volumes and vertical lengths to represent pressure, but it seems to us that you are better acquainted with what is called technically the "indicator diagram" than we are.

Up to this point we have been reasonably sure of our ground; it appears to us that so far as the practical working of a steam engine is concerned, we have more reason to learn from you than you to learn from us.

GOOD NEWS FOR MACHINE WORKMEN.

The Royal Electric Company, of Montreal, has recently closed several extensive contracts for large electrical machinery, which will keep their factory occupied night and day for more than a year, and necessitate a large increase in the number of their employees. They are advertising for a number of mechanics, to whom good wages will be paid.

They have added to their machinery equipment recently some of the largest tools of their kind in Canada, such as planers, boring mills and drills, and need men experienced on such tools. This is a hopeful evidence of improvement in Canadian manufacture and industry, the greatest part of their work being required for water power developments and railroad purposes. Evening News, Nov. 25th, 1896.

The Kay Electric Co., of Hamilton, have requested that the 25 per cent. duty on soft copper wire be removed.

Messrs. James Whitcomb, of Toledo, and James A. Bailey, of Detroit, are looking around for a suitable site in Canada for the establishment of carbon works.

* Paper read before the Hamilton Association of C. A. S. E.

ELECTRIC LIGHT INSPECTION STATISTICS.

THE annual report of the Commissioner of Inland Revenue for the Dominion, for the fiscal year ended June 30th, 1896, contains the first statistics compiled relating to the inspection of electric light meters under the provisions of the Electric Light Inspection Act, which went into operation in June of last year. The report states that offices for testing purposes have been fitted with the necessary apparatus at Windsor, London, Toronto, Hamilton, Belleville and Ottawa, in Ontario, at Montreal, Quebec and Sherbrooke, in Quebec, and at St. John, N. B., and Halifax, N. S. A set of Lord Kelvin's absolute standard apparatus, both for the measurement of current and potential, is being placed in position in the standards branch at Ottawa by Mr. O. Higman, electrical engineer of the department, which, it is expected, will prove of great value to electric lighting companies as a convenient means of standardizing their measuring instruments.

The total revenue during the year from registration and inspection of meters was \$8,681.25, and the expenses of the department \$6,603.23, a large portion of the latter being for permanent equipment.

It will be observed by the accompanying table that 3,705 meters were inspected, of which number only 110 were rejected, while four were verified after the first rejection. In the city of Ottawa there are the largest number of meters, 938, while Montreal has 626, Hamilton 537, and Toronto 345.

STATEMENT SHOWING THE NUMBER OF ELECTRIC LIGHT METERS VERIFIED, REJECTED AND VERIFIED AFTER REJECTION.

Districts.	Number.	Verified as coming within the error tolerated by law.			Rejected			Verified after first rejection as coming within the error tolerated by law.		
		Correct.	Fast.	Slow.	Un-sound.	Fast.	Slow.	Correct.	Fast.	Slow.
Belleville.	233	56	125	52						
Hamilton.	537	149	96	275				5		
London.	374	118	158	98						
Ottawa.	938	196	319	227	19	33	19			
Toronto.	345	4	219	22						
Montreal.	626	23	232	301	1	1	8			
Quebec.	216	20	99	87	4	1	2	1	2	
Sherbrooke.	6	6	1	1						
St. John.	196	35	71	75		1	1			
Halifax.	257	140	58	47	8	3		1		
Totals.	3,705	772	1,513	1,410	32	39	35	2	2	

The following statement shows the electric light companies registered under the Act during the year, together with the number of lamps operated. Each arc lamp is reckoned as equal to ten incandescents:

STATEMENT SHOWING THE ELECTRIC LIGHT COMPANIES REGISTERED UNDER THE ELECTRIC LIGHT INSPECTION ACT DURING THE YEAR ENDED 30TH JUNE, 1896.

FROM WHOM COLLECTED.	NUMBER OF LAMPS.		
	Arc.	Incandescent.	Totals.
Trenton Electric Company	53	103	633
R. R. Casement & Co., Montreal	40	400	212
W. H. Pearson & Co., Belleville	1	300	510
Corporation, Town of Picton	1,300	1,300	
Stormont Electric Light and Power Company	500	500	200
Vankleek Hill Electric Works	105	2,000	3,050
Kingston Light, Heat and Power Company	105	2,000	3,050
Napanee Water and Electric Light Company	105	2,000	3,050
Light, Heat and Power Company, Lindsay	105	2,000	3,050
Port Hope Electric Light and Power Company	105	2,000	3,050
Howmanville Electric Light Company	105	2,000	3,050
Peterborough Light and Power Company	105	2,000	3,050
Corporation of Campbellford	105	2,000	3,050
Lakefield Electric Light Company	105	2,000	3,050
Fenelon Falls Electric Light Company	105	2,000	3,050
Village of Colborne Electric Light	105	2,000	3,050
Colborne Electric Light and Power Company	105	2,000	3,050
W. H. & W. W. Foulds, Electric Light, Hastings	105	2,000	3,050
W. C. Harrison, Electric Light, Norwood	105	2,000	3,050
Milbrook Electric Light Company	105	2,000	3,050
Brookville Electric Light and Power Company	105	2,000	3,050
Morrisburg Electric Light (A. H. Merkle)	105	2,000	3,050

FROM WHOM COLLECTED.	NUMBER OF LAMPS.		
	Arc.	Incandescent.	Totals.
Gananoque Electric Light and Water Supply Company	16	1,600	1,760
Kemptville Electric Light Company	16	1,600	1,760
Merrickville Electric Company	16	1,600	1,760
Prescott Electric Light Company	16	1,600	1,760
Ingersoll Electric Power and Light Company	60	550	1,150
Beaufort Electric Light Company	60	550	1,150
Woodstock Electric Light, Power and Street Railway Co.	68	1,500	1,730
Brantford Electric and Power Company	50	2,200	2,700
Gas and Water Company, Simcoe	36	225	585
Paris Electric Light Company	15	32	182
Norwich Electric Light	20	24	474
Port Rowan Electric Light Company	34	142	472
Tilsburg Electric Light (F. J. Barkey)	34	142	472
Port Hope Electric Light Company	450	8,600	12,400
Hamilton Electric Light Company	35	38	388
Dumville Electric Light Company	50	1,440	1,940
Niagara Falls Electric Light, Heat and Power Company	29	50	978
Welland Electric Light Company	30	500	800
St. Catharines Electric Light and Power Company	68	900	1,580
Cayuga Electric Light and Power Company	9	359	449
Theorold Electric Light, Heat and Light, Metcalf	36	375	735
J. W. Vanduyke Electric Light Plant, Grimsby	8	250	800
Corporation of the Town of Niagara	350	5,155	8,655
Londan Electric Light Company	53	249	770
St. Thomas Gas Co., supplying Electric Power and Light	15	137	689
Fitzgerald & Sauermann Electric Light Company, Watford	14	50	190
Freeman N. Saylor, Strathroy	20	51	241
Petrolia Electric Light, Heat and Power Company	30	770	1,070
Barlton & Front, Petrolia	17	15	1,070
W. W. Gordon, Glenora	25	50	335
H. C. Baird & Son, Parkhill	26	75	335
Aylmer Electric Light Company	38	52	432
Stratford Gas Company	140	300	1,550
Clinton Electric Light Company	31	500	811
Cook Brothers Electric Light Company, Hensall	1	240	240
Corporation of the Town of Mitchell	47	430	530
Seaford Electric Light, Heat and Power Company	10	1,200	1,200
Palmerston Electric Light Company	10	340	350
Exeter Electric Light Company	10	200	300
Town of Goderich	84	100	840
St. Mary's Electric Light Company	33	2,400	2,430
Wingham Electric Light Company	50	600	1,000
Blyth Electric Light Plant (John B. Kelly)	17	140	310
Brussels Electric Light Company	21	10	220
People's Electric Light Company, Walkerville	4	2,000	2,000
Hiram Walker & Sons, Walkerville	1	1,200	1,200
W. A. Johnson & Co., Dresden	26	27	287
Smith & Anderson, Blenheim	10	79	267
J. & W. McMaster, Ridgeway	15	10	262
Wm. Laing, Essex	35	12	345
Tilbury Electric Light	30	15	345
Electric Company, Amherstburg	500	500	500
Chatham Gas Company	53	775	1,405
Wallaceburg Electric Light Company	40	15	452
Leamington Electric Light Company	21	206	416
Geo. Munro, Thamesville	7	175	245
Town of Orillia	500	50,000	55,000
Albert MacLaren, Buckingham	20	500	520
A. W. Wright & Co., Renfrew	20	800	1,000
Mackay & Guest, Renfrew	1	1,140	1,140
Citizens' Electric Light Company, Smith's Falls	1	1,000	1,000
Smith's Falls Electric Light Company	20	2,200	2,200
Carleton Place Electric Company	40	700	1,100
Almonte Electric Light Company	23	800	1,030
Pembroke Electric Light Company	28	2,200	2,480
Argovier Electric Light and Power Company	30	2,500	2,530
Perth Electric Light Company	47	1,000	1,047
Tay Electric Light Company, of Perth	1	1,000	1,000
Electric Light Company, of Keanville	1	300	300
Star Electric Light Company, of Keanville	1	300	300
Guelph Light and Power Company	100	1,400	2,400
Galt Gas Light Company	70	25	725
Berlin Gas Light Company	36	156	516
Waterloo Electric Company	24	30	320
Howes & Leighton, Harrison	22	50	270
Jacob Morley, New Hamburg	22	50	270
John Shearer, Villages of Blair and Preston	10	300	300
A. Groves, Febyville	35	1,000	1,035
Corley & Collins, Mount Forest	13	400	530
James Fenwick, Preston	30	70	320
James Fenwick, Hespler	24	35	275
Incandescent Light Company of Toronto	1,500	30,000	31,500
Toronto Electric Light Company	10	236	426
Milton Electric Light and Power Company	47	2,500	2,970
Barrie Electric Light Company	47	2,500	2,970
Penetanguishene & Midland St. Rail'd, Light & Power Co.	14	1,200	1,214
Midland Electric Company	35	500	850
Creemore Electric Light Company	135	135	135
Joseph Knox, Sturgesville	4	400	404
Glenwilliams Electric Light Company	15	450	465
W. J. Fletcher, Electric Light and Power Station, Alliston	20	350	550
Light, Heat and Power Company, of Newmarket	15	400	550
Hutton Electric Light Company, Brampton	26	300	550
Huntsville Electric Light Company	1	350	550
Nicholas Egan, Tottenham	150	150	150
Mattawa Electric Light and Power Company	900	900	900
Town of Brudenridge	1,700	1,700	1,700
John Bourke, Mattawa	7	703	703
Robert McGowan, Oakville	35	800	1,150
Lakefield and Whithy Electric Light Company	40	400	400
H. A. Train, Park's Electric Light Company	35	213	813
Port Perry Illuminating Company	50	410	940
Taigam Water and Light Company	11	500	610
Gravenhurst Electric and Trading Company	7	75	145
Appleton Electric Light Company, Grand Valley	26	800	1,110
Orangeville Electric Light and Power Company	18	50	230
Corporation of the Village of Markham	30	800	1,100
Robertson, Rowland & Company, Walkerton	55	300	750
Owen Sound Electric Illuminating and Man'g. Company	35	200	1,400
Corporation of the Town of Collingwood	19	525	715
Warton Electric Light Company	26	40	300
Orangeville Electric Light Company, Chesley	7	400	400
Donald McInryre Electric Light Company, Paisley	250	340	2,480
Win. Moore & Sons, Meaford	10	70	210
T. J. & R. Andrews, Thornbury	22	210	218
Stamington Electric Light Company	22	210	420
John Beaman, Chesley	12	208	420
Daniel Knechtel, Hanover	22	250	470
Durham Electric Light Company	33	1,266	1,592
La Corporation de la Ville de Joliette	23	5,400	68,500
Royal Electric Company	1,450	5,400	68,500

FROM WHOM COLLECTED.

NUMBER OF LAMPS.

Arc. Incandescent. Totals.

Citizens' Light and Power Company	200	800	2,800
La Compagnie Electrique St. Jean Baptiste		3,447	3,447
La Ville de Maisonneuve	26	319	579
Incorporation of the Town of Lachine	42	1,750	1,435
Temple Electric Company	20	4,750	1,050
J. B. Robert, Beaulieu		85	85
Valleyfield Electric Company		775	775
Electric Light Company of Terrebonne		334	334
Magline Oimet, St. Jerome		497	497
Montmorency Electric Power Company	405	10,500	14,500
Shroobroe Gas and Water Company	70	2,300	3,000
Richmond County Electric Company		877	577
Stansfeld Electric Light Company	25	900	1,150
Coaticook Electric Light Company	28	650	930
Parker & Howe, Dixville		125	85
French Bros., Sawyerville		80	80
La Compagnie des Pouvors Hydrauliques de St. Hyacinthe	2	3,000	3,020
La Compagnie pour l'Eclairage au Gaz de St. Hyacinthe	30	150	450
Granby Electric Light Company	35		350
Carleton Electric Light Company	3	375	575
St. John Railway Company	5	5,110	12,120
Fredericton Gas Light Company	80	200	1,000
Woodstock Electric Light Company		1,800	1,800
Sackville Electric Light and Telephone Company		495	495
Small & Fisher Company, Woodstock		500	500
St. Stephen Electric Light Company	40	183	383
City of Moncton Light and Water Department	92	975	1,895
Prince Edward Island Electric Company	80	2,000	2,800
Full Electric Light Company, Charlottetown		400	400
Hull Gas Light Company	75	2,000	2,950
Halifax Illuminating and Power Company	220	5,000	7,200
Dartmouth Gas, Electric Light, Heating and Power Co.		850	850
Windsor Electric Light and Power Company	12	1,350	1,470
"Chambers" Electric Light Company	65	2,900	3,550
Kentville Electric Light and Power Company		520	520
Acadia Edison Electric Company, Wolfville		500	500
Edison Electric Light and Power Company, Springhill		525	525
Lunenburg Gas Company		600	600
Bridgewater Electric Light and Water Power Company		475	475
Canada Electric Light Company, Amherst	26	1,500	1,760
North Sydney Electric Light Company		700	700
Sydney Gas and Electric Light Company		1,400	1,400
New Glasgow Electric Company	20	2,000	2,600
Digby Electric Light Plant		300	300
Bridgetown Electric Light Plant		200	200
Annapolis Electric Light Company		450	450
Citizens' Telephone and Electric Company, Rat Portage		3,500	3,500

SPARKS.

The town of Paris, Ont., is said to be considering the purchase of an electric plant.

An effort is being made to secure the installation of an electric lighting plant at Embro, Ont.

It is announced that another electric lighting company is likely to be started at St. John, N. B.

The electric light plant of the Hull Electric Company at Hull, Que., has been put in operation.

John Norwood, of Alvinston, Ont., has secured the contract for lighting that town by electricity.

It is rumored that an Ottawa firm propose putting in an opposition electric plant at Arnprior, Ont.

Mr. Tache is making arrangements to install an electric light plant for street lighting at Huntingdon, Que.

A dividend of 12 per cent. per annum has been declared by the Nelson Electric Light Company, of Nelson, B. C.

The conduits laid in the streets of Montreal by the Lachine Rapids Hydraulic & Land Company cover a distance of 80 miles.

A small addition is now being erected to the power house of the Hamilton Electric Light & Power Company at Hamilton, Ont.

The new electric light plant at St. Marys, Ont., will shortly be put in operation, the erection of the power house being nearly completed.

An electric light plant will be established at Shawville, Que., a company having been given twenty years' exemption from taxation.

In the city of Halifax, N. S., an agitation has been commenced towards having all electric light and telephone wires placed underground.

M. F. Beach & Company have been granted permission by the village council of Winchester, Ont., to erect poles for electric street lighting.

The Cocoa Matting Co., of Cobourg, Ont., have installed an isolated plant in their factory. The Canadian General Electric Co. secured the contract.

The new plant of the Sussex Electric Light Company was recently put in successful operation at Sussex, N. B. Over 400 lights have already been taken.

A despatch from New York states that the Commercial Cable Company have secured control of the Postal Telegraph Company,

and propose amalgamating it with their own system, issuing \$20,000,000 of debenture stocks.

Mr. Graham has made application to the village council of Norwich, Ont., for permission to erect poles and install a plant for incandescent and arc lighting.

The Toronto Electric Motor Company have requested that the present duty of 30 per cent. on magnet wire entering Canada from the United States be removed.

At the municipal elections in January a by-law will be voted on by the ratepayers of Bridgburg, Ont., granting an electric light franchise for fifteen years to D. A. Coste.

The town council of Magog, Que., have in view the purchase of a dam on the property of the B. A. Land Company in order to secure power for electric lighting purposes.

The municipality of St. Louis du Mile End, Que., have awarded the contract to the Citizens' Light and Power Co., for lighting the streets for the next thirteen years, also for residential lighting.

Horseless carriages are to be manufactured in Montreal, a company with a capital of \$10,000 having been organized for that purpose. It will be known as the Moto-Cycle Company of Canada, Limited.

The Minden & Northwestern Railway Company, which proposes constructing a railway from Ironde Junction to a point on the Georgian Bay district, ask for authority to use either steam or electricity as the motive power.

The British Columbia Electric Company, with head office at Tacoma, Washington, and a capital stock of \$10,000, has been registered to do business in British Columbia. Its purpose is to equip fire and burglar alarm systems.

With a view to increasing the steam capacity of the locomotives, the Grand Trunk Railway are enlarging the boilers of some of their passenger locomotives by the addition of a square top over the boiler next to the cab engine.

A test of horseless vehicles was recently made at London, England, in which fifty-four vehicles were entered, including several German inventions, the two Duryea carriages from the United States, and a large number of English manufacture.

Bothwell & Irving, solicitors, of Victoria, B. C., are asking for an extension of time for the commencement of the works contemplated by the Kootenay Power Company's Construction Act. One of the objects of this company is the production of electricity.

At a meeting of the Standard Light & Power Company, Limited, held in Montreal on the 27th ultimo, Mr. W. McLea Walbank was elected president and Mr. Jeffrey H. Burland vice-president. A retiring director was replaced by the election of Mr. W. S. Evans.

The city council of Winnipeg have now under consideration the question of purchasing an electric light plant to be controlled by the city. The scheme has been sanctioned by the council, and the ratepayers will be requested to authorize the expenditure of \$75,000 for the purpose.

At a recent meeting of the shareholders of the Parry Sound Electric Light Company, of Parry Sound, Ont., the chief business was the adoption of the auditor's report and the disposition of the surplus earning over cost of operation. The statement presented was considered satisfactory.

A despatch from St. Paul, Minn., states that a small rotary engine of novel design has been invented by Grant Brambel, of Sleepy Eye, Minn., for the patent of which Mr. H. F. Allen, of London, is said to have offered \$1,000,000. The engine does away entirely with the crank motion of the steam engine, and uses its own plunger for a cut-off. It is steam tight and requires no ring packing.

Letters patent have been issued incorporating the St. Jerome Power and Electric Light Company, of St. Jerome, Que. The capital stock is \$30,000, and the objects are to purchase the electric light plant now in operation at that town and to develop electric and water power for commercial purposes. Among the incorporators are C. L. Higgins and J. J. Westgate, of Montreal, and James Pearson, barrister, of Toronto.

As the result of a disagreement between the town authorities and the electric light company of Welland, Ont., the lights were recently shut off. Some time ago the council passed a resolution compelling the electric light company to raise the street lights at their own expense, which the manager of the company refused to do, and it is probable that tenders for a franchise for electric street lighting will be asked for in consequence.

ELECTRIC RAILWAY DEPARTMENT.

GUELPH STREET RAILWAY.

On the 17th of May, 1895, the first spike was driven on the above railway, by the president's amiable wife, in front of their residence, and four months later five miles of the road were in operation. Early this year another mile was completed, forming a belt line on which is located the baseball grounds.

It is claimed—and justly too—that it is the smoothest road in Canada. The rails on the new part are 65 lbs., while on the other part they are 50 lbs. It is a single track, with suspended trolley wires in the crowded parts of the city, while the rigid bracket is used in the less crowded streets.

A twenty minute service is provided on all the lines, and connections are made to and from all trains. There are three lines and a belt line, each starting from

of the power house. This saves the cost and operation of pumps. A large C. G. E. generator generates the electric current for the operation of the cars. The power house is sufficiently large to operate a twelve mile road.

The car barn is the same size as the power house and is similarly built; it has accommodation for about twelve cars.

The company is composed of the Sleeman family. Mr. Geo. Sleeman, sr., is the president, and Mr. E. Sleeman secretary and superintendent. The other offices are held by other members of the family.

The company own a pretty park near Waterloo ave., which they are laying out for the benefit of their patrons. It is probable that in the near future the road may be extended south west to Hespeler, in which event



GUELPH STREET RAILWAY.

the C. P. R. depot. One runs to the dairy building beyond the Ontario Agricultural College, climbing a steep hill on the way, and another runs down Waterloo ave., to the city limits in the south west, terminating at the Silver Creek Brewery. Both these lines run through the market place. The other line goes up Wyndham street—the main street—through St. George's Square, up Woolwich street to Elora Rd., and thence to the north west city limits. The belt line connects with the Waterloo ave. line at Edinburgh Rd., and with the Woolwich line at Suffolk street. On this line is the baseball grounds and the Collegiate Institute.

The rolling stock consists of five motor cars and a trailer, built by the Canadian General Electric Co. They are neatly furnished and upholstered.

The power house on Waterloo ave. is 100 x 40 feet in dimensions, with a ceiling 20 feet high, which is sheeted with Georgia pine. The two 100 h.p. Goldie & McCulloch boilers generate steam for a 150 h.p. cross compound Wheelock engine. There is space for another boiler and engine of the same power. In the basement is a large Northey condenser.

Water is supplied to the boiler by gravitation, there being a creek near by which is dammed 100 yards back

connection will be made with the large manufacturing town of Galt.

Application will be made to Parliament for the incorporation of a company to build an electric railway from Wabigoon, Ont., on the C. P. R., through the Manitou country to Rainy River, and touching nearly all the chief mining camps. Mr. E. A. C. Pew, of Toronto, is said to be one of the promoters.

Mr. Black, manager of the street railway at Niagara Falls, Ont., returned from New York a fortnight ago, where he interviewed the shareholders of the company with the object of converting the road to an electrical system. Nothing, however, can be done until next spring, and in the meantime present circumstances will have to alter considerably to secure the carrying out of the scheme, as the attitude of the council is said to be unfavorable thereto.

The Judicial Committee of the Privy Council has allowed an appeal, with costs, to the Edison Electric Company against the Westminster and Vancouver Tramway Companies, the Bank of British Columbia, and others. The Edison Company appealed against the decision of the Supreme Court of British Columbia granting a judgment in favor of the Bank of British Columbia against the tramway companies, to the prejudice of the Edison Company, who are the creditors of the tramways. The decision of the Judicial Committee of the Privy Council declares the judgment of the Supreme Court of British Columbia against the tramways to be null.

CANADIAN

ELECTRICAL NEWS

— AND —

STEAM ENGINEERING JOURNAL



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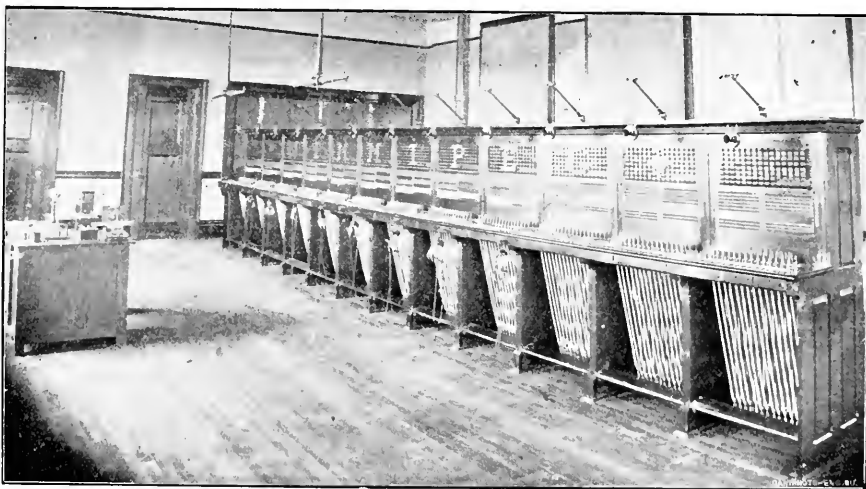
NEW BELL TELEPHONE EXCHANGE AT WINNIPEG.

THE Bell Telephone Company, of Canada, has recently completed a new exchange in the city of Winnipeg which is one of the most efficient in the country. The building is situated on Thistle street, near Main; constructed of white brick and faced with brown stone; it is two stories in height and is used exclusively by the telephone company.

In the basement are the distributing room, inspectors' and linemen's quarters and the heating apparatus. On

ard form in use in so many of the offices of the company. The switch has a capacity of twelve hundred lines. The present number connected up is about nine hundred. Each operator has charge of one hundred lines, which are brought through jacks to the annunciators in the usual way.

Some difficulty has, in the past, been experienced with boards, where it is necessary to transfer connections from one section to another, in having the line properly disconnected when the conversation was finished. A special feature has been introduced into



OPERATING ROOM, SHOWING FRONT OF SWITCHBOARD, BELL TELEPHONE EXCHANGE, WINNIPEG.

the ground floor are the company's general offices, with the district superintendent's private office, the power room, and a room in which is installed the city fire alarm apparatus, which is operated by the telephone company. The upper storey is used for the operating room and the operators' retiring and lunch rooms.

All the wires enter the building under ground in paper insulated cables, and are carried through flexible rubber cable-heads direct to the distributing frame, which is of the most modern type, and equipped with the best lightning arresters and strong current protectors known. The wire used in the distributing frame is insulated with wool, a novel feature, designed to make the mass of wires as flame-proof as possible. From the distributing frame the lines are carried in small cables up to the switch-board.

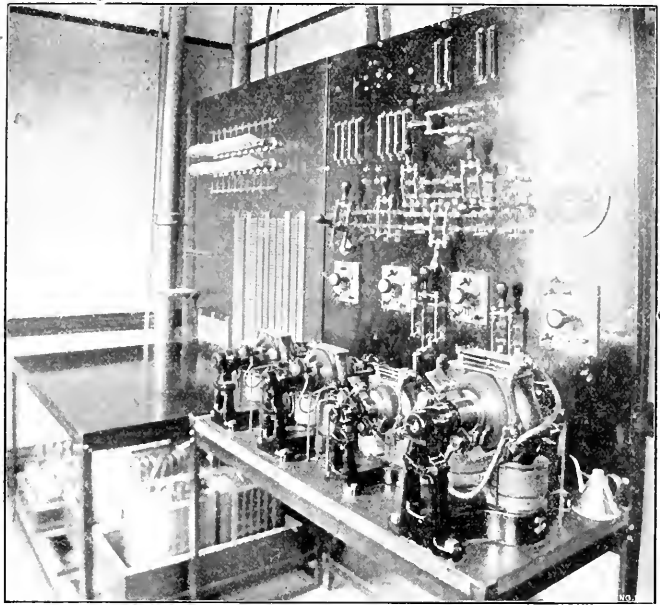
The switch-board is of somewhat novel construction, being a decided improvement on the well-known stand-

board to obviate the trouble. One hundred and eighty transfer lines are multiplied through all the boards, fifteen being brought back and terminated at each section in cords and plugs. Let into the key-board, in front of each plug, is a miniature four-volt incandescent lamp, connected up in such a way as to glow when the transfer line plug is in a jack and the other end of the transfer line is open, thus furnishing a most accurate disconnect signal.

The operation of making a connection from one switch to another is as follows:—Suppose operator on section No. 2 receives a call from subscriber 234, for subscriber No. 781—the operator on No. 2 section depresses the order wire key connected to the operator's telephone on the 7th section and says "781." The operator on the 7th section sees at a glance what transfer lines she has idle at her section; picking up any one of these plugs she repeats back to No. 2 operator "781

on 6" (for example), at the same time inserting the 6th transfer line plug into line jack 781. The operator on No. 2 section now inserts the front cord of the pair with which she has answered subscriber No. 234 into the 6th transfer line jack of the 15 leading to the 7th section. On the termination of the conversation the subscriber rings off, throwing the ring-off drop connected with the pair of cords in use on section No. 2. The operator at the section comes in on the line after assuring herself that the conversation is finished, and withdraws the cords from the jacks. This causes the lamp in front of transfer plug No. 6 on the 7th section to glow, showing the operator at that section that the conversation is finished, whereupon she, in her turn, removes the plug from the jack and, on replacing it into its socket, the lamp goes out. These supervisory signals enable the operators to do very much more work than under the old system. All the details of the board jacks, drops, keys, etc.—are of the very latest design and of the most substantial construction, and should ensure good service with a minimum amount of trouble.

The current for operating the switch-board and other



POWER ROOM, SHOWING MOTOR-GENERATORS, SWITCHES, STORAGE BATTERIES AND RESISTANCE LAMPS.

transmitters, supplying the four-volt lamps, operating the fire alarm, together with the alternating current required for signalling the subscribers, is furnished by the power plant on the first floor of the building. This consists of two motor-generators for charging storage batteries, and two motor-generators furnishing an alternating current for signalling the subscribers, four chloride cells furnishing current for the transmitters and lamps, and twenty-four small cells operating the fire alarm.

The power switch-board is of polished slate, on which are mounted all switches, lightning arresters, cut-outs, ammeters, etc., used in connection with the system.

The lines were successfully transferred from the old to the new offices on the evening of the 25th October, 1896, the total time occupied in making the transfer of the lines being about two minutes.

The entire apparatus was manufactured for the Bell Telephone Company by the Northern Electric & Manufacturing Company, of 31 Aqueduct Street, Montreal.

Mr. F. G. Walsh, the district superintendent of the northwestern department of the Bell Telephone Co., has also the direct supervision of the Winnipeg office, with which he has been connected from the time of the first introduction of the telephone in the Northwest, and to his ability, energy and good judgment much of the company's success in this section must be ascribed.



REAR VIEW OF SECTION OF SWITCHBOARD, SHOWING METHOD OF WIRING.

The Winnipeg street railway system was recently tied up for several hours owing to a sudden thaw, followed by a blizzard. Manitoba is having an exceptional winter of sudden changes in temperature.

The new electric light plant at St. Mary's, Ont., was successfully started on the first of December. It is composed of twenty-eight 2,000 c.p. "Reliance" arc lamps, supplied with current from a Reliance dynamo, which is giving thorough satisfaction. It was installed by Mr. H. H. Ingram, of Seaford, and is now in charge of Mr. Jos. H. Ward, electrician, late of Toronto, who is also installing a small incandescent plant to light Messrs. Weir & Weir's flax mills, which furnish the power for the arc plant.

FIRST CANADIAN MOTOR CARRIAGE.

THE interest which has been taken of late in the horseless vehicle in many parts of the world received a local impetus by the appearance on the streets of Toronto last month of the first motor carriage yet constructed or to be seen in Canada. Appearing shortly after the test which took place in England, and which is said to have been a good demonstration of the utility of this class of carriage, there was much interest manifested in the success of the trial trip, which revealed no disappointment.

The carriage was constructed for Mr. Fred. B. Featherstonhaugh, patent solicitor, the electrical equipment being the design of Mr. W. J. Still, of 70 Yorkville ave., Toronto. The general design of the carriage is after the style of the London hansom cab, except that the driver occupies a seat inside, instead of being perched up at the back. It is hung on ball bearings and mounted on three wheels, with 2-inch Dunlop pneumatic tires. The two wheels at the back are 28 inches in diameter and the front wheel 20 inches. It is supplied with a top, and as an extra precaution against the weather a celluloid blind, perfectly transparent, may be used when required. The total weight of the carriage is approximately 750 pounds, of which 370 pounds is for the electrical equipment. It is estimated that it could be placed upon the market at a cost of about \$650, including electrical equipment, which would cost from \$200 to \$300.

The storage battery is placed directly under the seat, and contains 12 cells weighing $23\frac{1}{2}$ lbs. each. They occupy a space about 16 x 24 inches and 14 inches deep, and are what is known as the lead-lead pasted type, being the invention of Mr. Still, for which patents have been applied. The electrical contents of the cells are $4\frac{1}{4}$ h.p. hours, or, in other words, they will give one horse power for $4\frac{1}{4}$ hours. The cost of re-charging is about twenty-five cents. Mr. Still claims that they are built particularly for high discharge rate work, and are fully one-half lighter than any storage battery yet placed upon the market. The controller has three positions, giving 6, 12 and 24 volts. It is an iron bar with a handle to the right of the seat, and is also used for steering. The device is very simple, and enables the driver to propel or reverse the carriage almost instantly. The motor, also the invention of Mr. Still, is four maximum h.p., and is supported on the back axle. It is geared 12 to 1 to the driving wheels, and hung on roller bearings. On the dash-board are two incandescent carriage lamps supplied by the battery.

Mr. Still states that the carriage differs from any yet constructed, both in the class of cells, character of motor and controlling apparatus, and is built especially for town and city purposes. When the battery is fully charged it is estimated that it will be capable of propelling the carriage about 60 miles before requiring to be re-charged, making an average of 12 miles an hour for five hours. On a level road three-quarters of a horse power is required per hour for its operation, but on steep grades this, of course, would be greatly increased. The trial trips which have been made on the city streets have fully met the expectations of those interested, and prove that at least the construction of the machine is mechanically and scientifically correct.

Mr. Still, the inventor of the electrical apparatus, is an Englishman, who came to this country seven years ago. He was not originally connected with electrical

work, but was prompted, he says, to make experiments in that line through sheer necessity. He required a motor for a special purpose, but could not obtain one to meet the requirements, so set to work to study the science himself, with the result that he shortly afterwards designed a motor and secured a patent therefor. Subsequently he turned his attention to the storage battery, and after diligent research his efforts promise to be rewarded. It is his intention to form a syndicate to manufacture cells and motors for railway and locomotive work. One of the objections to storage batteries has been their great weight, but this Mr. Still claims to have overcome in the article which he will shortly place upon the market.

QUESTIONS AND ANSWERS.

"R. M.," Milton, Ont., writes: How should I cut a coil out of an Edison exciter armature? Should I cut the two wires loose from the section and then close that section to the next one? What should I do with the wire that I cut loose? If the sections are near together can more than one be cut out?

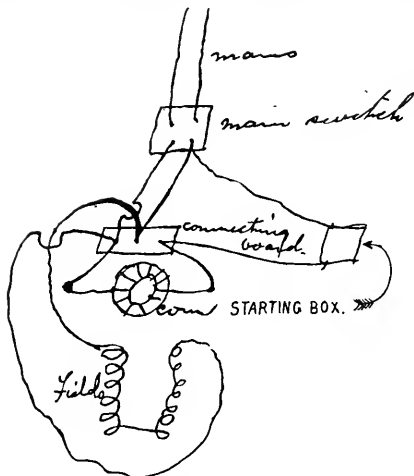
ANSWER.—We should suggest that if you feel in the least doubtful about the results of cutting out the coil, you should send the armature to some repair shop where they do such things. You have the general idea all right. Don't do anything with the wires you cut loose, but take care they don't come together or touch anything else. If they touched together they would form a closed circuit of low resistance in which a large current would continually flow, and great heat would probably result. You can, of course, cut out as many sections as you like, but must remember that the armature will probably lose its electrical balance.

"U.M.A.X." writes: Would you kindly let me know in your NEWS for January what causes an electric light machine to go to sleep, and the best thing to do in such cases. I am told that one of the machines in the Ottawa power house went to sleep, and after three or four days started up again. And is it not right to have all wires free from touching trees or branches? I claim that all wires should be clear, as such contact would cause grounds on the lines.

ANSWER.—The only thing that could cause a dynamo to "go to sleep" would be the complete demagnetization of the fields, and it is difficult to understand how this could occur in a place where the machines are run every night. It is more probable that a connection was loose somewhere, or a wire broken, so that the fields were not magnetized. It would be interesting to hear from Ottawa about this case. You are quite right in your claim that all wires should be clear of any chance of rubbing against branches, etc.; grounds are caused by this continual rubbing, which tends to scrape off the insulation, leaving the copper in actual contact with a body that is generally, at least, moist, and frequently quite wet, and therefore a good conductor. Besides which insulation is not much good anyway, and after a few months' exposure to the air will leak through.

"B. E.," Hawkesbury, Ont., writes: "As a subscriber to the ELECTRICAL NEWS, kindly assist me out of a difficulty. I am operating a 4 h. p. ball motor on a 110 volt straight current circuit, which formerly worked on a 4 ampere constant current circuit. If I am not mistaken the machine should require about 35 amperes at

110 volts, but I cannot get more than 25 amperes on the meter on the 25 K. W. Edison machine, from which it is driven. The winding is correct, having come from its maker. The connections are all correct, for it works well except as regards its power and speed. The distance from generator to motor is about 100 yards, and very little loss is shown on the volt meters. The data is No. 12 D.C.C. on armature (it being ring type), and No. 18 S.C.C. on field magnets. The field magnets show about the same strength of magnetism. The voltage test was taken while running. The mains from the generator are No. 8 B. & S. w.p. wire, and are sufficiently heavy for 35 amperes, the motors only requiring about 32 amperes at full load. The weight of field coils is 20 lbs. No. 18 B. & S. S.C.C. and armature 33 lbs. required No. 12 B. & S., D.C.C.; there were some five or seven pounds left over after winding the armature. I have enclosed a sketch of the connec-



tions. The speed of the machine is reduced to about one half when it is working.

ANSWER.—The wires leading from generator to motor are entirely too small. The safe carrying capacity independent of most advantageous size for No. 8 is only 25 amperes. The loss between generator and motor with 32 amperes at 100 yards with No. 8 B. & S. wire would be about 15 volts, or 14 per cent. There are other reasons, however, that might cause the trouble. The position of brushes may not be correct. The proportion of wire appears about right. It is difficult to diagnose a case unless we see the patient. I think, however, the whole trouble is that the line is too small.

PERSONAL.

Mr. George Campbell, manager of the Winnipeg Electric Railway, has severed his connection with the road, to engage in mining operations.

Mr. Maurice Quain, electrician, of Ottawa, Ont., left last month for Rossland, B. C., where he has secured a position with a large mining company. Before leaving Ottawa he was tendered a farewell supper.

Mr. Frank Green, electrician of the Hamilton, Grimsby and Beamsville railway, has resigned, and accepted a similar position with the Hamilton Radial Railway. It is expected that other changes will be made in the Hamilton, Grimsby and Beamsville railway at an early date.

Mr. R. G. Moles, proprietor of the electric light plant at Arnprior, Ont., declined to accept municipal honors at the late election, after serving for seven years as reeve and three years as mayor. During his regime the best interests of the town had been advanced, and his retirement was a source of regret to the citizens.

Readers of this journal will regret to learn of the serious illness of Mr. A. E. Edkins, inspector for the Boiler Inspection and Insurance Co., of Toronto, and Registrar of the Ontario Association of Stationary Engineers. An attack of inflammation of the lungs was followed by an abscess on the brain, which necessitated a surgical operation. For several days he was thought to be beyond medical skill, but as we go to press it is learned that he is somewhat better, and hopes are now held of his recovery. The ELECTRICAL NEWS joins with his many friends in hoping that he may speedily return to convalescence.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

LONDON NO. 5.

THE above association is in a prosperous condition, and all the meetings are well attended. Two new members have recently been initiated, and the applications of four others are now awaiting to be passed upon. At the last meeting a debate took place on "Steam Engine Economy," which was ably discussed and illustrated. The Association has been presented with forty catalogues from manufacturers.

KINGSTON NO. 10.

At a meeting of Kingston No. 10 held on December 10th, papers were read by Messrs. R. Priestly and W. Woodrow relating to the horse power of steam engines and boilers. Mr. F. W. Simmons followed by an essay on the latest production of electricity directly from coal, illustrating the subject by experiments and the use of charts. Below will be found the calculations of Mr. Priestly, which we have simplified in some respects:

RULE: To find the horse power of a boiler always find the number of square inches and divide by 144, which gives the square feet of heating surface, and divide by fifteen square feet, which is an average allowance for one horse power of a boiler. Divide the horse power by 2 and you have the proper grate surface, and allow $\frac{1}{2}$ square inch of safety valve to each square foot of grate surface generally. From $\frac{1}{2}$ to $\frac{3}{4}$ of a square foot grate surface is allowed to each horse power of a boiler. To find the horse power of a boiler, find the number of square feet of heating surface and divide by 15. Fifteen square feet of heating surface is the general allowance for a h. p. of a boiler.

EXAMPLE:

Let D = diameter.

T = tubes.

H = heads.

S = shell.

L = length.

Heating surface in S = $\frac{2}{3}$ of total area of S.

$\therefore \frac{2}{3}$ (D of S \times 3.1416 \times L of S) = $\frac{2}{3}$ ($4' \times 3.1416 \times 25'$) = 209.44 sq. ft.

Heating surface in H = area of H - area of ends of 2 T.

$2(D \text{ of } H \times .7854) - 4(D \text{ of } T \times .7854)$

$2(4' \times 4' \times .7854) - 4(16' \times 16' \times .7854) = 2.0944$ sq. ft.

Heating surface of tubes =

$2(D \text{ of } T \times .7854 \times L \text{ of } T) = \frac{2(16' \times 16' \times .7854 \times 25 \times 12)}{144} = 209.44$ sq. ft.

Total heating surface = 209.44 + 2.0944 + 209.44 = 420.9744 sq. ft.

15 sq. ft. per h.p.

\therefore h.p. of boiler = $\frac{420.9744}{15}$, or about 28 h.p.—Ans.

RULE: To find the horse power generated in any kind of a boiler when running, first, notice how long it will take to evaporate 1 inch of water in the glass gauge, divide this into 60, which gives number of inches evaporated in one hour; second, multiply the average diameter where evaporation took place by the length of the boiler in inches; this multiplied by the number of inches evaporated and the answer divided by .1728 gives the cubic feet of water evaporated in one hour.

There is no such thing as a horse power to a steam boiler—it is a measure applicable only to dynamic effect; but as boilers are necessary to drive steam engines the same measure applied to steam engines is now universally applied to the boiler. The standard as fixed is one cubic foot of water evaporated per hour from and at 212 degrees. For such horse power this at that time was the requirement of the best engine in use. At the Centennial Exposition in 1876, a board of engineers selected from all parts of the world adopted as a standard for tests of boilers 30 pounds of water evaporated per hour under a steam pressure of 70 pounds per square inch as representing one boiler horse power. The general rule in estimating horse power of boilers is based on its evaporating one cubic foot of water horse power per hour one foot, or 62 $\frac{1}{2}$ pounds, or 6 $\frac{23}{100}$ gallons of water evaporated per hour is equivalent to one horse power; that is, a boiler that will evaporate ten cubic feet of water, 625 pounds of water, or 6 $\frac{23}{100}$ gallons of water per hour is a boiler of 10 horse power.

CHEMISTRY IN THE BOILER ROOM.

By Wm. Thompson, Montreal West.

PERHAPS a more elaborate heading might have been chosen, but after careful consideration of the importance to be attached to the requirements of the engineering profession and the actual need of at least a rudimentary education in chemistry before an engineer can become acquainted with what is really taking place in the plant under his charge, I cannot think of a more suitable or appropriate title for the subject to be discussed.

All engineers, no matter how practical, require a theoretical education, and to this end associations have been established where engineers can meet together and discuss the various branches of their profession. Varying degrees of success have been attained, and in a large number of cases a new enthusiasm has been propagated and many engineers have been turned from mere "machines" to thoughtful, earnest men, anxious to know their business, and resulting in a new class of engineers having been formed who are well acquainted with the nature of the duties required of them, and giving to the steam-user a greater degree of confidence in the ability of his engineer; on the other hand giving to the engineer a degree of confidence in himself that was formerly an unknown quantity, and establishing the usefulness of the steam engine as a producer of power more fully and with more favor than heretofore.

The designer and builder of steam engines and boilers in Canada has, I think, kept pace with the demand upon his energy and resources, and he can to-day bravely and confidently face competition from whatsoever source, and prove that a steam plant is not the hungry article many people would have the consumer believe. The designer, however, to enjoy success, must of necessity have the co-operation and assistance of the operating engineer. A modern plant in the hands of an engineer who only knows enough to oil and "tinker" stands a mighty poor chance of proving an unqualified success. The importance of this has already been evidenced by the establishment by the engineers themselves, of the organizations already mentioned, and more particularly by the establishment in our leading universities of faculties to impart this important knowledge. A new era seems to be opening up in engineering circles, when ability will be more readily recognized and when an engineer will require another kind of ability than that necessary to do a certain amount of manual labor in a given time, or a certain amount of wire-pulling to secure a "job." Prominent evidence of this can be seen by the recent decision of the Toronto City Council to appoint the engineer to the new city hall by a competitive examination.

Public safety demands that every engineer should pass a qualifying examination before being allowed to take charge of a steam plant, although, unfortunately, we have no general law to this effect. Where these examinations are in effect, candidates are examined on what may be termed a graduated scale, and certificates granted accordingly. The examination comprises, as it very properly should, a close examination on the strength and management of boilers—such as the required thickness of plate, diameter and pressure being given; the safe working pressure, thickness of plate and diameter being given; the strain per sectional inch, thickness of plate, diameter and pressure being given; the required strength of furnaces and flues under varying conditions; strength of plate at joints as compared with solid plate; strength of all riveted joints, etc. In other words, the examination proceeds under the well known theory that the weakest part of a boiler is its greatest safe working stress, and no engineer should under any circumstances be allowed to take responsible charge of any steam boiler until these questions are thoroughly understood, any more than a navy out of a ditch should be called upon to prescribe for a case of smallpox or other disease.

If, then, public safety requires the engineer to have a certain theoretical as well as practical knowledge and experience, his employer will require a certain other knowledge, and his own pride and skill in his employment will demand that he acquire all the knowledge possible as to what takes place from the coal pile to the time he turns out his power as the finished article. Unfortunately this knowledge is not easily acquired even after years of experience, and when the engineer has mastered the operation of his engine, he stops there and looks no further.

Every engineer who is at all observant knows that combustion takes place under certain defined conditions, and that in many cases a sediment is formed in his boiler feed water that is a constant cause of anxiety to him and a menace to the life of his boiler, and that from some cause or other a certain deterioration gradually takes place in his boiler plates, stays and other acces-

sories; that different conditions exist under different circumstances, and to such an extent that it seems almost impossible to master the various difficulties.

A close student of chemistry will find that in nearly every case the cause of these varying conditions is the result of a certain chemical reaction constantly taking place, and also that a knowledge of chemistry, enabling the operator to understand the reaction, will also enable him to neutralize the reaction to a greater or less degree. Hence it becomes essential that an engineer, to thoroughly understand and comprehend what is constantly taking place from coal pile to finished power, requires a knowledge of chemistry, and the more complete our chemical knowledge, the better and more proficient engineers we shall certainly become.

It is not my intention to undertake at the present time to discuss all the chemical reactions that may usually be expected to take place, but in the present instance to discuss, and as plainly as possible, the chemical reaction constantly taking place during the combustion of fuel.

As every engineer knows, coal is a black, inert mass, obtainable in many grades and degrees of efficiency; that when supplied with draught and heat it burns up and disappears, giving off during this operation both heat and light, and that it is this peculiarity that makes it so valuable and generally used for the production of power. If our knowledge stops here we have really learnt nothing of any importance. Then, engineers, go still further, and note that during the process of "burning," as usually styled, certain gases are formed which have a given calorific value, and to save fuel we must take precaution to utilize these gases. We know as a matter of fact that these inflammable gases had no existence as such when coal was placed in the furnace, consequently they must have been formed after being placed within the furnace, and by some process not at once understood. We all know this to be an actual fact; then in the face of this, is it not reasonable for us to endeavor to learn—first, what is the composition of coal that gives it this peculiarity of burning up and throwing out heat? We know that it does this, but "why?" Why will not clay, iron, stone, sand or any other mineral do the same work or behave in the same way under similar conditions? We know they will not, but when asked "why?" we have simply to say we do not know. Now, if coal has this peculiarity, and under certain conditions forms gases, there is certainly a reason for it, and fortunately for us the chemical art places all these things in simple array before us, so that they are easily understood and actually placed under our control. This very fact leads me to say that the more chemical knowledge we can obtain, the better engineers we shall become. No matter how clever you are you cannot intelligently operate an engine unless you understand it, and for the same reason you cannot intelligently produce power from coal unless the process of combustion is fully understood. We want to know what coal is, what are its component parts, what makes it burn, why gases are formed, what they are, how formed, how burned to give best results, and why, when coal burns, it gives off heat, and how much, and finally what becomes of it.

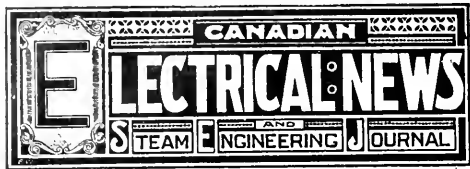
Coal burnt is not destroyed; it has simply changed from a black inanimate mass into some other substance or substances which we shall consider later on.

(To be Continued.)

IMPORTANT PATENT DECISION.

By recent decision of the United States Circuit Court at Cincinnati, O., the Dodge and Philon patent for separable wood pulleys, covering the compression fastening and interchangeable bushing system, is broadly sustained. Under the patent laws, the user, the seller and the manufacturer are all held to be infringers and liable as such to the owners of the patent. The Dodge Wood Split Pulley Company, of Toronto, is taking proceedings against infringers of their patent in Canada.

We have received from the publisher, Mr. Chas. A. Hewitt, 510 Royal Building, Chicago, a copy of a book entitled "The National Electrical Code," by Price & Richardson, electrical engineers. It is an analysis and explanation of the Underwriters' electrical code, and the common analogies and simple definitions used make it easily intelligible to non-experts. The authors have undertaken to explain the matter in ordinary language for the special benefit of insurance inspectors and electrical students, as well as central station men. In the appendix are found tables and curves for measuring wires, and the full text of the underwriters' code, Price \$2.00.



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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Looking Backward and Forward.

In all business it is of importance to balance up at certain periods—to take stock of what is left in hand, to see whether the business has improved or not since last stock-taking, and from the operations undertaken to derive some useful information which may increase the experience, or indicate in what particular direction the business will be capable of extension in the future. Engineering works are as easily reduced to book-keeping as any other business, and it will be of considerable value to every engineer—no matter whether he belong to the civil, mechanical, or electrical branch of the profession—to periodically edit, so to speak, the experience gained during the preceding year or so, with the view of enabling him either to avoid errors in the future or of strengthening his convictions along any particular line. In electricity such a review is likely to be of even greater value than in the other branches, for the science is now in the period of vigorous growth and extension, when almost every week adds something new to our knowledge, and experiences crowd in so thick and fast that we are sometimes almost bewildered with their number and variety. And yet it will never do to say "Enough," for a slight halt will mean falling far behind in the race of progress. This progress has become evident along very many lines, and has every prospect of being permanent. As the student becomes more and more interested in the countless problems presented to him, so does his desire for knowledge increase, so does his comprehension improve, and in like proportion do his results become more satisfactory. It is especially remarkable that for some time, the interest evinced by those responsible for the operation of electric lighting and power houses in Canada has stimulated a more thorough investigation into the economics of central station practice. These investigations have been fruit-

ful of results, leading in very many cases to a startling change in methods of operating, and in some few to scrapping or alteration of entire plants. It is observable that electric plants are being more and more recognized as capable of careful designing; that the opinion is growing and taking firm hold, that the various component machines and apparatus are all intended to work together as one coherent, harmonious whole, and that therefore the due and proper proportion of boilers, engines, generators, etc., to each other should be carefully calculated. This conviction has led to considerable attention being paid to the preliminary engineering, to which little or no importance used to be attached. Speaking generally, however, the past year has been memorable for the breaking away from old-time ideas and opinions, for the somewhat cautious acceptance of those principles of practical electricity which have been experimentally determined in Europe and the United States, and for the general awakening to the fact that electricity is a special science, to be studied as such. We are now shaking off the fetters placed on the industry by an extreme conservatism; we are climbing out of the ruts marked for us by manufacturing exigencies, and are learning more to think for ourselves. This is really the cause of the developments that have taken place along many lines, and is a favorable augury for the future. The lines of progress may be grouped into probably four, viz.: Improvements in Engineering Practice; Improvements in Manufacturing; Improvements in Operating Practice; Application of Electric Power in New Directions.

Taking these up seriatim: It is quite remarkable how, in the last twelve months, the engineering of electrical enterprises has received great and increasing attention. The European practice of placing all engineering details from water power or steam plant, right up to the distribution system of a lighting, or the transmission system of a railway plant, in the hands of competent engineers in independent practice, is apparently becoming more favorably considered among us, with the most beneficial and evident results. By the adoption of such a course electrical enterprises have been more and more planned with reference to the engineering and commercial conditions of a particular case; have been designed as means to particular ends, and less and less as so many "ads" for a particular "system." In this we are adopting the course so strongly recommended by American electrical publications, as tending to better engineering, and therefore to greater pecuniary success.

In manufacturing also we have seen great improvements and extensions. At least two quite new manufacturing companies have entered the field, and purchasers have now a very much more extended market wherein to select what they consider most suitable for their wants. For lighting purposes we now are able to choose between generators representing three well known types—inductor, iron-clad and surface-wound armatures. Alternating arc lamps, and long burning arcs on constant potential circuits, are quite numerous, and giving good satisfaction, and what is of special importance to single phase central stations, a single phase alternating current motor is now obtainable, and giving good results, in sizes up to 10 h.p. and larger. Whereas a couple of years ago direct current generators and motors were sold only by about four companies, now

we find at least nine different makes, and all good. The consequent competition, while it has greatly reduced the cost of goods, has also happily necessitated great improvements in their quality and efficiency; competition has been along the lines of improvement as well as along that of price only. In lamps and transformers the same result is noticeable—competition has forced a much closer study of the principles of design and construction of all apparatus, with consequent benefit to the purchaser. In alternating current apparatus the market has been extended so as to include two new makes of generator, and at least one entirely novel form of watt-meter. Electric railway apparatus does not seem to have broken new ground yet, although in the near future we may reasonably expect great advances.

As power machinery, two and three-phase generators, with motors both induction and synchronous, represent quite the highest development of such apparatus, we would not be justified in expecting any marked improvements or modifications for some time yet. In this line probably the most interesting and important achievement is that by which we are enabled to transform a set of currents bearing one particular phase relation to another set bearing a quite different relation. That is to say, we can transform a two-phase to a three-phase, and vice versa; so that, for instance, current may be generated in two-phase by a suitable machine, and if desired it can be transmitted to any reasonable distance as a three-phase and then transformed back to a two-phase or used as a three-phase, as may be most convenient.

In steam engine circles we have had occasion to welcome the introduction of another first-class high-speed engine. In the matter of improvement in operating practice the industry has great cause to congratulate itself on the marked progress made, and more especially on the fact that it is a natural one, having been started spontaneously in operating circles, and not as a kind of unnatural growth. The continually increasing interest taken in electrical matters by the owners and operators of central stations, large and small, has led to a more careful investigation into results, which in turn has itself pointed out many possible economies. Younger men are more frequently found in the positions of electrician and engineer—men whose ideas have not been formed in the very early days of electrical activity, and who therefore have had nothing to unlearn before acquiring the new notions. Study seems to be more general, and the conviction growing that in electricity the more one studies the more one finds to study. In steam practice particularly, it is very encouraging to find that properly qualified engineers, holding certificates from some recognized authority, are more generally sought for, and that the holder of a certificate takes a better position, and frequently can command higher pay, than one not so vouched for. This is entirely as it should be, and we should like to see the principle extended to the granting of certificates, after due examination by some competent authority, to electrical men. This infusion of younger blood has had very beneficial results in many cases, and it is not difficult to predicate that within the next few years we shall hear a different story from central station men who now write in the doleful plaint: "Electricity doesn't pay."

In the line of new enterprises we can chronicle some that place Canada at least in respectable competition

with other countries. When the Lachine Power Co. and the Chambly Power Co. have completed their constructions, Montreal will take a front place among cities as regards its power facilities; and there are other proposed power enterprises, such as that of the Keewatin Power Co., whose magnitude will be unrivalled. The advantages of electrical distribution of power through factories and cities have been more cordially acknowledged by the manufacturing interest, and we see with satisfaction that motors are used in cotton mills, paper mills, etc., displacing small, inefficient steam engines. Electricity is also forcing its way "electrolytically," as witness a western Ontario salt works using current for the electro-deposition of salt. It is to be regretted that storage batteries are not yet received among us, as aids in power houses. In the railway line there has not been a great deal to notice, but the very many enterprises in the promotion stage augur a wonderful activity in the near future. There has been for some time before the public a proposed long railway to connect points in eastern and western Ontario, utilizing several water powers along its route, and transmitting current therefrom over great distances, but it is well to be cautious in expressing any opinion as to such very extensive enterprises.

A forecast of probable electrical developments in the near future seems to indicate a great activity in all lines. Manufacturers will in all likelihood have their hands full of business, but competition—if the public cares to avail itself of the advantage—will keep prices down. Inductor type alternators, both single and polyphase, will probably grow in favor and in time displace the older types of armature. We hope to see the 220-volt lamp take a front place in new work. In railway work it seems probable that the alternating current will evolve up to the commercial point, and produce an induction motor suited for railway requirements. We also hope and believe that the improvement in operating practice will be even more satisfactory during the coming twelve months than in the past. We would suggest that the good resolutions for '97 should include the following: Careful reading and study; an examination into the economics of our power houses; an experimental study of our distribution systems, including transformers; a sharp look-out for any new methods or devices whereby we can increase our efficiency or decrease our expenses.

THE Montreal Street Railway Company

Turkey and Pudding. are said to have distributed six tons of turkey and three tons of plum pudding among their employees at Christmas. We are not informed as to whether the company's system was in workable condition or not on the day following the festival, but presuming it to have been, it speaks wonders for the digestive powers of the staff.

Standard of Efficiency for Incandescent Lamps. A COMMITTEE recently appointed by the German Electrical Institute to investigate this subject, and draft a set of standard rules and regulations for the guidance of manufacturers and consumers, has concluded its labors. Among the recommendations is one to permit of a variation of 2 per cent. in the voltage marking of lamps ordered, the lamps to be tested by the marking. It is suggested that a variation of 6 per cent. in candle power or energy be permitted, but the lamps may be rejected

if it is found that upwards of 25 per cent. of the lamps tested exceed these limits. The standard of lamp life is to be the number of hours at which the lamp has lost 20 per cent. of its rated candle power when operating at normal voltage.

Prevention of Accidents from Electricity.

A CARD containing warnings and suggestions designed to prevent injury to persons from contact with electric currents has been issued by the Manufacturers' Accident Association of France, to be posted in all factories where electric currents or electric apparatus are employed. It is prescribed that work, workmen, iron tools, or other objects not connected with the electrical machinery, should not be allowed to come in proximity thereto. It is recommended that rubber carpets or mats or board platforms supported on glass or brick should be placed on the floor about the machines for the attendants to walk upon while in the discharge of their duties. Attention is called to the fact that an imperceptible puncture will destroy the protective quality of a rubber glove, and for this reason persons handling wires should use one hand only and keep the other as far removed as possible from wire or metal of any kind. In case fire should appear around any wire, switchboard, or other electrical apparatus, it is absolutely forbidden to throw water or wet cloths on it, or to allow anything of the kind to come in contact with any wires or electrical apparatus whatever until the current has been shut off from the locality by cutting the wires or otherwise. High tension wires are not to be touched on any pretext, however thick the insulation; and no person is to be allowed to enter, without special authority, the place where transformers are installed, or to carry a light or smoke in a room containing accumulators. In regard to the latter it is explained that the action of accumulators is accompanied by the evolution of hydrogen gas, so that explosions may easily occur, unless the place is well ventilated and fire kept out of it.

The Future of the Horseless Vehicle.

ELSEWHERE in this number is printed particulars of a motor carriage which has been invented, manufactured and practically tested in Toronto. The vehicle is propelled by electricity generated by a storage battery. While it is gratifying to know that Canada is well to the front in this as in other lines of development, the question presents itself, what useful purpose is likely to be served by such a vehicle that is not now as well served by the horse, the electric car and the bicycle? In other words, can the need for motor vehicles be demonstrated in a way to lead to their introduction and use on a large scale? To us it does not seem probable that they could be made to displace the horse to any extent either outside or inside of cities. In the country the horse is employed for a variety of purposes in addition to traction. This, added to the fact that ordinary horseflesh is cheap and cheaply maintained for country purposes, seems practically to shut the door in this direction to the motor vehicle. On the contrary, in cities, transit requirements for freight and passengers appear to be cheaply and efficiently supplied by horses, electric cars and bicycles. Even now, as compared with a few years ago, horses have largely disappeared from our streets. Those that remain are chiefly employed for cartage purposes or for the pleasure of the wealthy. For neither of these purposes does the motor vehicle seem as well adapted

or likely to come into favor. It might be employed for the carrying of light parcels, but unless its estimated cost can be greatly reduced, it will prove too expensive for this purpose. If any of our readers can find a basis on which to form a more sanguine estimate of the outlook for the motor vehicle, we would be pleased to publish their views on the subject.

THE revolution in lighting which was predicted from the discovery of acetylene gas has not assumed a material form, and, judging by the indications, never will. If the discovery had been as valuable as many persons supposed it to be, the time which has elapsed since it was publicly announced would have sufficed to give it a commercial standing. Instead of advancing it appears to be fast retrograding in public esteem, as it becomes better known. Its dangerous character can be judged by the restrictions with which the Chicago Board of Underwriters has surrounded its use. These restrictions are briefly as follows:—“The apparatus for the generation or storage of the gas or of calcium carbide to be contained in a fireproof building detached from any insured building at least ten feet, and not elsewhere on the premises. 2. The valves or devices of whatever nature for controlling the pressure of the gas shall be located inside the fireproof building above described, and a cut-off provided between said building and the building insured. 3. The piping of the building insured shall be provided with a pipe outlet into the open air, controlled by a safety device so arranged as to let the gas escape outside the building insured whenever the pressure on the piping in the building exceeds four ounces to the square inch. This permit is granted in consideration of the agreement of the insured to comply with the above restrictions and conditions. The generation, storage or use of acetylene gas or of calcium carbide in violation of the restrictions and conditions named is hereby agreed and declared to be an increase of hazard that is not assumed under this policy, and in case of any such violation this policy shall thenceforth be null and void.” It is a foregone conclusion that a method of lighting which is thus marked “dangerous,” and which can only be used under special and inconvenient conditions such as those stipulated by the Underwriters’ Association of Chicago, will never find its way into general use. The trend of events in relation to this discovery is also seen in the fact that shares of the Acetylene Company, of New York, after being quoted at \$400, are said to have been recently sold for 50 cents.

KEEP ON ADVERTISING.

No business man not yet dead in the shell but can see even in dull times an opportunity to let the world know that he is alive. In advertising one’s business it is perhaps three times out of four a blind and fatal mistake to leave the public in the dark as to whether the factory is still running and the owner thereof alive or dead. No industry that is not overdone or wrongly located can be effectually downed by a spell of depression. Consumers do not quit the world as some gentlemen did in the days of Noah, and if unable to purchase what they need to-day, the same need speaks for itself tomorrow. When the wind is low, mend your sails, and the man who is prepared for the breeze is the man most benefitted by the same.—Power and Transmission.

BY THE WAY.

ONE of the most attractive window advertisements ever shown in Canada has been constructed by the aid of electricity, to draw public attention to the Massey-Harris Company’s bicycle. The frame of a bicycle placed in the window of the company’s show-room on Yonge street, Toronto, has been covered with small incandescent lights, which, when lighted, display the outline of the machine in a variety of beautiful colors. By the aid of a miniature electric motor the machine is shown in operation. Electricity played an important part in the window decorations of the great stores during the holiday season, and is continually coming more and more into evidence for decorative purposes at public and private assemblies.

× × × ×

It may serve to illustrate the ability of the electric light to hold its own against any other form of illuminant, if I repeat a little story which a friend of mine related to me the other day. “I had occasion,” said he, “to visit recently a little German village in Western Ontario, and was surprised to find the streets and business places lighted by incandescent lights. In the hotel where I put up there were twelve lights. Curious to know what profit was being made by the owner of the lighting plant, I enquired of the hotel man, how much his lights cost him. “Shust von cent each for efery nighd,” was the reply. “Do you mean to tell me,” said I, “that you pay only about 70 cents per week for 12 incandescent lights.” “That’s shust about id,” said he, and added, “it ust to cost me 20 cents a nighd ven I burnd lamps.” “Well,” said I, “I guess the owner of the lighting plant doesn’t make anything out of the business.” “Doesn’t he?” replied the hotel man, with a sarcastic smile, “he gets his mill lighted for noddings!” It will doubtless be comforting to the hearts of owners of electric lighting plants to know that in one instance at least the modern illuminant has been able to distance all competitors, but municipal corporations and others will do well to beware of drawing from this incident the inference that there are heaps of money to be made in the electric lighting business.

APPARATUS FOR TESTING COAL.

AN apparatus by which an engineer may test or determine the quality and adaptation of the coal he receives is described in the Boston Journal of Commerce. The test is not intended to be an analysis, but principally to show the amount of fixed carbon in the coal and the percentage of ash. As each carload of coal is received, samples are taken from twenty or more parts of the car, thoroughly mixed and quartered, each quarter being also mixed and quartered until the sample is obtained; this sample is then carefully weighed, the volatile matter driven off, weighed again, and the carbon consumed and the ash weighed. This estimate is important in guarding against the use of coal having an undue percentage of ash. The various coals differ in percentage of ash which they contain, some Cumberland coals having from 12 to 14 per cent of ash, while a good New River will have as low as 3 or 4 per cent. Thus, though the coals may look alike to the average engineer, the heat value characterizing them is 10 per cent greater in one description than the other, and, ascertaining this, an important saving in the cost of fuel may result.

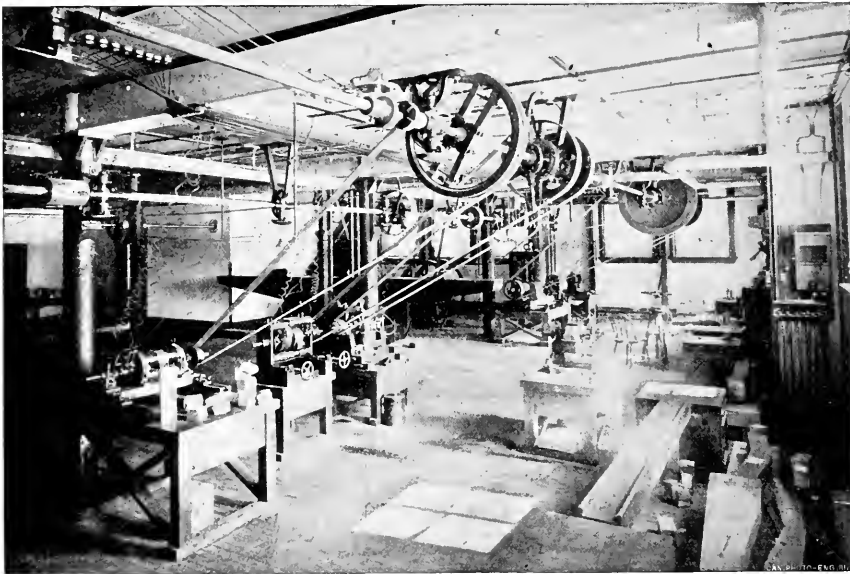
TORONTO SCHOOL OF PRACTICAL SCIENCE.

THE necessity of providing facilities by which the young men of the country might obtain a thorough scientific training, to fit them for the positions which were afforded by the developments in the civil, mechanical and electrical engineering field, was first recognized by the Ontario Government in the year 1887, when an act was passed sanctioning the establishment of a School of Practical Science. Arrangements were made with the Council of University College by which the students of the School of Science were permitted to enjoy the advantage of the instruction given by the University professors in all the departments of science embraced by the work of the school, and when, in 1880, these departments were transferred to the University of Toronto, the Senate passed a statute affiliating the school with the University. In that year Professor Galbraith was appointed by the govern-

this journal are more particularly interested. The engineering laboratory occupies two floors, and has a total area of 10,000 square feet. It is divided into three departments—the department for testing materials of construction, the department for investigating the principles governing the application of power, subdivided into the steam laboratory, the hydraulic laboratory, and electrical laboratory, and the department for investigating problems connected with standards of length, time, astronomical observations, etc.

In the equipment for testing materials is included an Olson torsion engine for testing the strength and elasticity of shafting. This machine will twist shaft up to 16 feet in length and two inches in diameter. The equipment of the power department is as follows:

A Babcock & Wilcox 52 horse-power boiler; A Harrison-Wharton 12 horse-power boiler; a 50 horse-power Brown engine, constructed specially for experimental investigation. It is steam jacketed, and has



DYNAMO ROOM, SCHOOL OF PRACTICAL SCIENCE, TORONTO.

ment as principal of the school, and the management thereof was entrusted to a council of which he was chairman.

The regular departments of instruction are five in number, viz: Civil engineering (including sanitary engineering), mining engineering, mechanical and electrical engineering, architecture, analytical and applied chemistry.

The regular course in each department is of three years' duration, at the completion of which the diploma of the school is granted to the student. The equipment of the school has been proceeded with year by year, and is now almost complete. There are the chemical, blow pipe, and assaying, stamp mill, electrical, meteorological, hydraulic, steam engine, and the testing of materials laboratories, in all of which the appliances are of a standard in keeping with the requirements of a first-class school.

We give herewith illustrations and some particulars of the engineering equipment, in which the readers of

three alternative exhausts to the open air, to a jet condenser, and to a Wheeler surface condenser—presented to the school by Mr. F. M. Wheeler of New York, the inventor. There are also a Blake circulating pump, a Knowles air pump and a Blake boiler feed pump (the latter being a gift from the manufacturers), and a machine for testing lubricating oils and measuring journal friction, built by Richie Bros., Philadelphia.

The hydraulic division is furnished with a three throw pump, having a capacity of 500,000 gallons per 24 hours. There are also large tanks furnished with orifices, and weirs, measuring tanks, etc. A three feet jet turbine, a nine inch McCormick and a six inch New American turbine, the latter the gift of William Kennedy & Sons, of Owen Sound, are also included, together with the usual measuring instruments, indicators, gauges, gauge testing apparatus, scales, brakes and dynamometers. The shafting is driven by a 7 horse-power Otto gas engine, a 20 K.W. Edison motor, and a Brown engine.

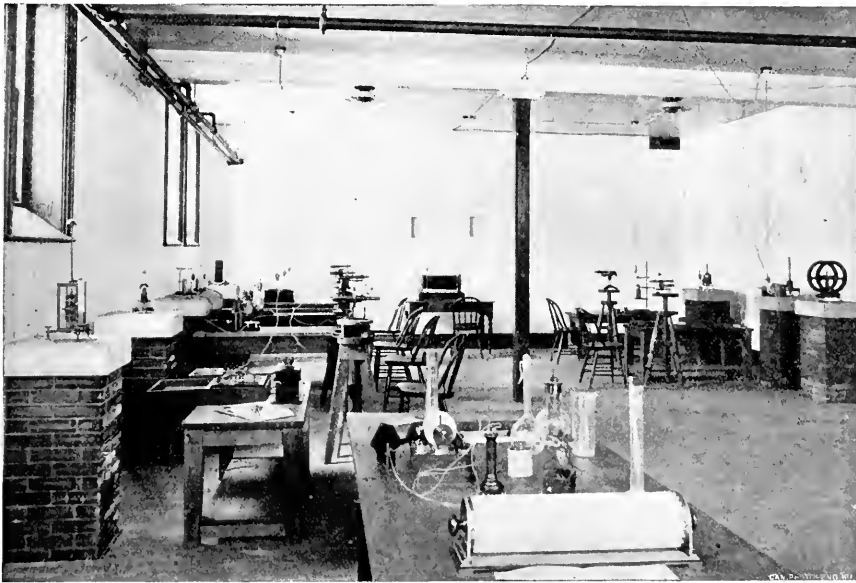
Coming to the electrical laboratory, the first section is the engineering division, in which a 20 K.W. motor furnishes the power to drive several continuous current dynamos of constant potential and current, as well as an alternator. There are two motors of 6 and 3 h.p., besides several smaller motors, one of which is for alternating current. Recently there have been added a polyphase motor, and a rotary converter. On the walls, besides rheostats, are four types of transformers and meters for continuous and alternating currents. Arc lamps of seven types are hung around the laboratory, and incandescent lamps which may be used for the purposes of a rheostat. There are also a battery of Roberts storage cells and several chloride accumulators. A new switchboard is being constructed under the personal supervision of Mr. Rosebrugh, which, in addition to affording facility for inter-connection, will also carry measuring instruments which may be readily introduced into any circuit. A Thomson balance,

The electrical apparatus in connection with the University of Toronto, to which students have access also, includes electrometers, galvanometers, resistance coils and bridges, testing keys, batteries, electrical machines (Holz and Carre), Ruhmkorff coils, Crookes' tubes, telephones, etc.

Electricity has also been used to facilitate the study of the science of architecture, a powerful electrical stereopticon being employed for the illustration of designs.

In the mining department a six K.W. constant potential motor, supplied by 110 volt incandescent circuit of the city, and made by the Canadian General Electric Co., at Peterboro', is used for driving the machines for making tests of ore, etc.

In addition to taking the course of instruction in the school and passing the requisite examinations a candidate for the diploma in mechanical and electrical engineering is required to present satisfactory evidence



GALVANOMETER LABORATORY, SCHOOL OF PRACTICAL SCIENCE, TORONTO.

multicellular electrostatic voltmeter, and high potential electrostatic voltmeter, a Siemens' electro-dynamometer, and standard Weston measuring instruments furnish the means either of accurate observation or for standardization of instruments for ordinary use. These are generally used in a separate room, to which connection is made. The second section of the electrical laboratory is a room 24 by 49 feet, in another part of the basement, from which iron has as far as possible been removed. Here ten masonry piers support galvanometers, an electrometer, and other mirror reflecting instruments, and testing work can be done free from disturbing influences. Fume cupboards and sinks have been provided for work with galvanic and storage cells; the room is also supplied with Wheatstone bridges, Kohirausch apparatus for electrolytes, standard divided microfarad condenser, Clark cells and other apparatus. Wires leading from this room to the switchboard allow measurements to be made in connection with experiments in the other laboratory. Connections to the 110-volt circuit of the city are accessible in all the rooms.

of having had at least one year's good practical experience in one of the principal occupations connected with mechanical work, such as machinist, pattern-maker, moulder, steam engineer, etc. There is no restriction as to the place where the candidate may have gained such practical experience.

In connection with the school there is the Engineering Society, which is carried on by the students, with the approval and encouragement of the teachers.

The efforts of Prof. Galbraith, the Principal, to maintain the high standard of the school have met with much success, while the cost of its maintenance is said to be less than any similar institution. Mr. T. R. Rosebrugh, M.A., is lecturer in electrical engineering, assisted by Mr. A. E. Blackwood; Mr. J. A. Duff, B.A., is lecturer in applied mechanics, and Mr. W. Minty, B.A.Sc., in mechanical engineering.

The ratepayers of Alexandria, Ont., are moving in the direction of securing an electric railway from the Canada Atlantic depot to Green Valley, a distance of $4\frac{1}{2}$ miles.

THE ROMANCE OF THE TELEGRAPH.

THE December number of the Methodist Magazine contains an article under the above title by Marion Norma Brock, in which the fact is related that in China, when the telegraph line was built at Foochow, the people broke it every night, believing it would cast an evil spell over the country. They considered even the shadow of a pole falling across a tomb as a desecration, and as the graves in China are often in the private gardens, it was difficult to secure "way leaves," for neither love nor money would induce the Chinaman to tolerate this sacrilege. The natives of Senegal have a superstitious dread of what they call the "white man's talking-jumbo," and both line and linesmen are left unmolested. In Coomassie, the natives left the white man's wire alone after they had constructed a thread line of their own and so satisfied their self-respect.

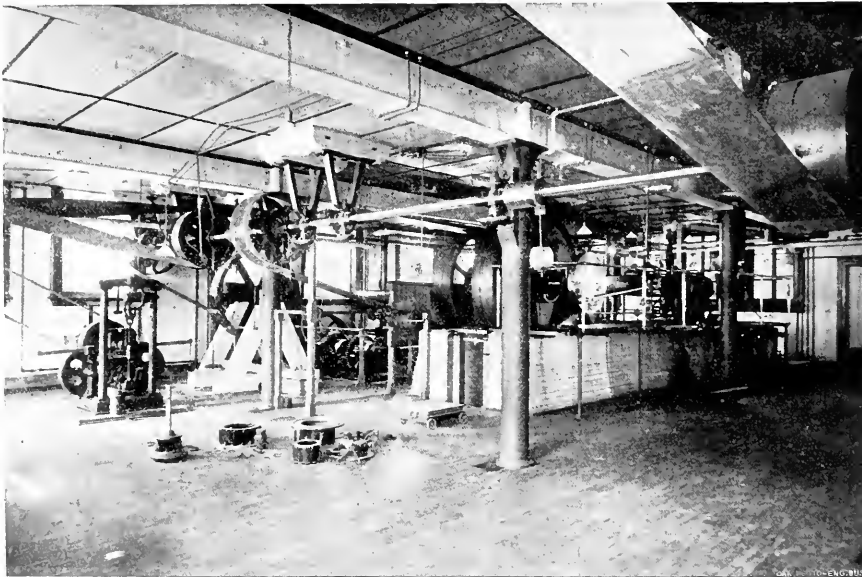
The writer of this article alludes to the vigorous

The bison, on the plains of the Great West, found the accommodating posts could be pleasantly used as currycombs. They were, however, not at all durable for this purpose, as the bison gave them vigorous usage. To protect the poles from such treatment, sharp iron spikes were driven into a large number of them. But this ingenious device did not work well, for the buffalos regarded the spikes as a great improvement to their currycombs, and chose the spiked poles every time in preference to the others.

RESIGNATION OF MR. RUTHERFORD.

Mr. W. Rutherford, chief engineer of the Canadian General Electric Company, has resigned his position, to accept the management of the electric traction department, which is now being established by the well-known English engineering and contracting firm of Dick, Kerr & Company.

Mr. Rutherford's experience in mechanical and electrical engineering, gained first in Cardiff, Wales, then with the Thomson-Houston International Electric Company in South America and



EXPERIMENTAL ENGINE, SCHOOL OF PRACTICAL SCIENCE, TORONTO.

opposition to the land wires offered by the animal creation. We are told that in some parts of Norway, the lower part of the poles has to be protected in order to keep the bears from clawing them to pieces, under the supposition that the humming of the wires is the drone of insects within the posts. The large woodpecker of Norway and the green woodpecker of California, probably deceived in the same manner as the bears, bore myriads of holes in the posts. Our busy Canadian woodpecker appears to be more sagacious—at least his attacks on the telegraph pole have not been frequent enough to be anywhere recorded. In the tropics, the posts have been treated with creosote, where iron poles are not used, to prevent the destructive raids made by the white ants. Monkeys find the wires of the telegraph make delightful performing bars, and frequently use them in their gymnastic exercises, thus causing a serious leakage of the current. Mischief-loving elephants, in the glory of their strength, will occasionally perform the feat of levelling a dozen poles or more.

elsewhere, and finally since 1890 as chief engineer of the Toronto Construction and Electrical Supply Company and the Canadian General Electric Co., has been such as to render him eminently fitted for the important and responsible position which he is about to undertake. Practically the entire period of electric railway development in this country is covered by the five years which Mr. Rutherford has spent with the Canadian company, in his official connection with which he has had the supervision of the engineering features of the greater number of the important electric railway installations throughout the Dominion. The engineering firm of Dick, Kerr & Co. is one of the largest in Great Britain, their business as manufacturers of rails and general railway supplies being carried on in all parts of the world. In Canada they are principally known as selling agents for the Phenix steel rails, used on the Toronto and Montreal railway systems. That they should have considered the present an opportune moment for entering the electric railway field may be taken as establishing the fact that the long deferred development of electric traction in Great Britain has commenced in earnest. The ELECTRICAL NEWS, while regretting Mr. Rutherford's departure from the ranks of Canadian electrical engineers, feels at the same time bound to congratulate him on the enlarged scope of his future work, and Messrs Dick, Kerr & Company on having secured the right man for the right place.

SPARKS.

The 15 year old son of Wm. Cruse was killed in Kingston by an electric car.

Geo. Alexander has been granted a franchise for electric lighting at Kaslo, B. C.

The Hull Electric Co. will place an additional dynamo at the power house, Deschenes Mills.

Parrsboro, N. S., will probably be lighted by electricity. The question of purchasing a plant is now under consideration by the town.

It is said that Greenwood, Ont., will shortly be lighted by electricity. It is intended to utilize the water power in the neighborhood.

The annual meeting of the shareholders of the Toronto Street Railway Company will be held in Toronto on the 20th of this month.

The West Kootenay Power and Light Company and the Kootenay Power and Light Company, of Kootenay, B. C., are seeking incorporation.

Messrs. Plewes & Spence, of Creemore, Ont., have secured the contract of lighting the streets of Colborne, and will put in an electric light plant.

A new 7,000 light dynamo has recently been placed in No. 5 power house of the Ottawa Electric Co. This dynamo replaces eight 750-light machines.

An action was brought by Mr. Easton to recover \$60,000 damages from the Brantford Street Railway Company for injuries received in an accident, by which he has become paralyzed. A verdict for \$12,000 has been given.

A company in which Mayor Elliott, of Brantford, is interested, propose building an electric railway from Brantford to Ayr, via Paris, and another from Brantford to Port Dover. The city of Brantford will be asked to grant a bonus.

It is reported that on condition that the Dominion Government will assist, the Grand Trunk Railway Co. have offered to convert the Victoria Bridge at Montreal into a double-track structure, with an additional track for a trolley service.

The whole of the lines of the Consolidated Railway & Light Company, of Vancouver, B. C., were offered for sale by auction by Mr. W. H. Hooper by order of the Yorkshire Guarantee & Securities Company, trustees for the bondholders, but no offers were received.

The Hull Electric Co. are busy building their double track between Aylmer and Hull. When the road is rebalasted in the spring and the double track finished into Aylmer, Mr. Spencer asserts that the run will be made in fifteen minutes or at a rate of about forty miles an hour.

James Best has begun an action against the Hamilton Street Railway Company for damages for being put off a street car after having dropped a punched 5 cent piece in the fare box. The conductor, he alleges, refused to allow him to ride to his destination unless he paid the second time therefor, the coin with a hole in it not being acceptable.

The Superintendent of the Government Telegraphic Service is engaged in preparing for the extension of telegraph lines from Esquimaux Point, Que., the present easterly terminus of the line on the north shore of the gulf, to Belle Isle. In the course of the next year it is expected to add about 80 miles of line, which will carry the wires as far as Natishquan, 666 miles below Quebec.

The city council of Halifax are not satisfied with the service supplied by the street railway company, and resolutions have been adopted authorizing that legal proceedings be taken if in thirty days the company do not furnish the council with time table and scale of fees and system of transfers. The city engineer has also been instructed to report on the cost of an electric light plant to be controlled by the city.

A charter has been granted to the British Columbia Tunneling and Development Company, Limited, of Rossland. The purpose of the company is to construct a tunnel through Red Mountain, and to construct double tracks on which it is proposed to operate electric cars to convey ore from the different mines. The projectors of the undertaking are J. F. McLaughlin, W. A. Campbell, and John J. Moynahan, and Col. Frank Moberley is preparing estimates of the work.

The new combined passenger, baggage and mail car now being constructed for the Ottawa Electric Railway will shortly be completed. It will be a fine piece of workmanship. The interior will

be finished in polished oak and beautifully carved and the windows in the passenger portion will be of plate glass. The length of the car will be 28 feet. The compartment for passengers will be at one end, the baggage room in the centre, and the mail matter room at the other end.

It is reported that a company has been organized in Philadelphia to promote a system of gold mining without removing the ore from the earth. The scheme is to sink shafts a few inches apart and pump into them a suitable dissolvent. A strong electric current is then to be passed through the soil between the shafts. The action of the electric current is claimed to be that it will carry with it the dissolved gold from one shaft to the other and deposit it there on any metallic circuit in the same manner as electro-plating.

The Toronto Radial Railway Company is seeking incorporation from the Ontario Legislature to acquire the franchise and property of the Toronto Belt Line Railway Company, or any other company operating or having the right to operate an electric or other railway in the city of Toronto, or within fifty miles thereof. The company propose to convert into an electric road the steam railway which was constructed around Toronto some years ago by the Grand Trunk Railway. Messrs. Mercer, Bradford & Titus are acting as solicitors.

Mr. James Hill, of Cleveland, Ohio, has just completed the construction of a chimney for the St. John (N. B.) Electric Railway Company, which is the third largest in Canada. The chimney is 177 feet in height from the ground and goes beneath the ground 32 feet, where it rests on a solid rock foundation. It contains, approximately 400,000 brick. The foundation is 18 feet square, and this exterior size is preserved to a height of 40 feet above the ground. From that point up it is rounded and below the top it narrows to 10 feet 6 inches, swelling out to 12 feet nine inches at the top.

The transmission of electric current from Newcastle to Sacramento, Cal., has been successfully performed. The distance is thirty miles. Three high potential wires carry the current from the power house to the station, which is furnished with two motors and two arc light dynamos, which run 120 arc lights. It has also eight step-down transformers to reduce the voltage, and the switchboard is furnished with several of the latest improvements. A current of 15,000 volts was turned on at Newcastle to test the line, and it was found to be in perfect order when reaching Sacramento.

There is an engine built 150 years ago, which is said to be still in use in a coal mine in England, doing duty five hours a day. It pumps water from a shaft 750 feet deep. The engine is considered to be the oldest steam user in the world, being built by a blacksmith named Newcomen. The engine works at a pressure of two and a half pounds to the square inch, giving a little over fifty horse power. Its weight is about 600 pounds. The cylinder is five and a half feet in diameter with a six foot stroke. The walking beam is of oak. The father and grandfather of the present engineer preceded him at the post of operating the Adam of all steam engines, so that three generations have had the honor of operating the ancient piece of machinery.

The waterworks and electric light systems of the corporation of Sudbury were successfully started a few days ago. They are operating from their alternating current two-phase dynamo, furnished by the Royal Electric Co. of Montreal, over 1000 16 c. p. incandescent lamps, 16 street arc lamps of the Helios type of 2000 c. p. each, and a number of small motors driving printing presses, meat choppers, etc. The power house, in which are erected the pumps as well as the electric light and steam power, is a solid brick structure 2½ stories high in the main part, with a boiler room extension, solid stone basement, cement and hardwood floors, and situated close to the lake on property bought for the purpose. The plant consists of two boilers of 60 h. p. each, made by Jenckes, of Sherbrooke, two Northey duplex pumps with a capacity of 30,000 gallons per hour, one 125 h. p. Wheelock automatic engine with condenser, one 75 k.w. "S.K.C." generator, with station apparatus complete. The water is forced by the pumps into a steel tank built on a steel tower, which holds 70,000 gallons. The elevation of the tower gives 82 lbs. pressure at the hydrants, which is ample to put a fire stream over the highest building in the town. The city fathers and the people in general are highly pleased with the entire plant and much credit is due to the engineers, Messrs. J. R. Gordon, C. E., and L. V. Rorke, D. L. S., for the first-class manner in which this second and new plant was installed.

MOONLIGHT SCHEDULE FOR JANUARY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 5:15	A. M. 6:25	13.10
2.....	" 5:15	" 6:25	13.10
3.....	" 5:15	" 6:25	13.10
4.....	" 5:30	" 6:25	12.55
5.....	" 6:00	" 6:25	12.25
6.....	" 6:50	" 6:25	11.35
7.....	" 8:00	" 6:25	10.25
8.....	" 9:10	" 6:25	9.15
9.....	" 10:30	" 6:20	7.50
10.....	" 11:30	" 6:20	6.50
11.....	"	"	5.50
12.....	A.M. 12:30	" 6:20	4.40
13.....	" 1:40	" 6:20	3.20
14.....	" 3:00	" 6:20	2.20
15.....	" 4:00	" 6:20	1.20
16.....	No light.	No light.	.....
17.....	No light.	No light.	.....
18.....	No light.	No light.	.....
19.....	No light.	No light.	.....
20.....	P. M. 5:30	P. M. 8:30	3.00
21.....	" 5:30	" 9:40	4.10
22.....	" 5:30	" 9:40	4.10
23.....	" 5:30	" 11:00	5.30
24.....	" 5:30	" 12:00	6.30
25.....	" 5:30	A. M. 1:30	8.00
26.....	" 5:35	" 3:00	9.25
27.....	" 5:35	" 4:10	10.35
28.....	" 5:35	" 5:30	11.55
29.....	" 5:35	" 6:10	12.35
30.....	" 5:35	" 6:10	12.35
31.....	" 5:35	" 6:10	12.35

Total, 227.55

TRADE NOTES.

It is said to be the intention of the Canadian Pacific Ry. Co. to substitute mica and wool for the wooden covering which has hitherto been used on their locomotive boilers.

Beginning with the new year the name of the well-known manufacturers of leather belting, Messrs. Robin, Sadler & Haworth, was changed to "Sadler & Haworth." With this change the business will be conducted exactly as before.

Mr. R. E. T. Pringle, Montreal, agent for the Packard Electric Co., Ltd., of St. Catharines, Ont., has recently opened a large store at No. 216 St. James St., Montreal. Mr. Pringle's largely increased business has necessitated this, and he is fortunate in having one of the best located electrical stores in Montreal.

The Royal Electric Co. are installing an electric lighting plant for Wm. Irving, of Sundridge. They are furnishing one of their latest type two-phase "S.K.C." 25 k. w. dynamos. Contracts have already been secured for about 200 lights, and also for one motor to run off the same two-phase alternating circuit.

The Consolidated Milling Co., of Peterboro', are having their large mills lighted by electricity. The Royal Electric Co. is furnishing the dynamo and material, and Mr. J. H. Greer, of Peterboro', is installing the plant. The Consolidated Milling Co. expect to run about 24 hours per day, from which it would appear that they have plenty of business in view.

We are advised that as the result of their rapidly increasing business the Packard Electric Co., of St. Catharines, will shortly be compelled to double the capacity of their plant for the manufacture of lamps and transformers. They report having brought their transformers up to the highest stage of efficiency, and that they are finding excellent sale for their Scheffler watt meters.

The Dodge Wood Split Pulley Company, of 74 York street, Toronto, are now offering for immediate delivery high grade turned and polished steel shafting in any diameter and in any length up to 24 feet each; new designs in either compression, grim-death or flange couplings; hangers of all kinds, any drop, of latest style, adjustable in all directions, with either plain bearings or the Dodge Company's new patent capillary self-oiling bearings. This is positively claimed to be the most up-to-date line of power transmission appliances on the market, and manufacturers and others using shafting, hangers, pulleys, clutches, etc., will do well to get the company's prices when in want.

The Brantford Electric & Operating Co. have purchased from the Royal Electric Co., of Montreal, and now have in operation in their station, a 150 k. w. "S.K.C." two-phase alternating current dynamo. This company had a number of serious misfortunes with its lighting apparatus, and desired a new machine delivered there quickly. The order was given to the Royal Electric Co., of Montreal, on December 5th at 5 p.m., and on Friday, December 11th, the dynamo was furnishing light to the city of Brantford. It was ready for operation in a little more than five days after the order was given. It was set up in running order in the factory of the Royal Electric Co., in Montreal, had to be dismantled and boxed, shipped to Brantford and there unboxed and put together again, set on foundations and connected to the old systems. The time of transit was from 6 p.m. Monday, until 12 noon, Thursday. The balance of the time was consumed in dismantling and boxing

at Montreal and unboxing and setting up in Brantford. It is the intention of the Brantford Electric & Operating Co. in future to furnish power from the two-phase system. In this they are following the lead of a number of the best companies in Canada. This "S.K.C." dynamo was purchased under the new management of the Brantford Electric & Operating Co., and shows unmistakably that they are prepared to remain in the front rank of the electrical business.

SPARKS.

An addition is being built to the works of the Montmorency Electric Co., Montmorency Falls, Que.

The employees of the Ottawa Electric Light Co. lately presented Mr. W. G. Bradley, superintendent of construction of arc lights, with a beautiful gold locket.

The Thompson Electric Co., formerly of Waterford, Ont., will remove to Hamilton, where they have secured the large Wanzer premises and will continue the manufacture of dynamos, arc lamps, and other electrical apparatus.

The city council of Chatham, Ont., are wrestling with the question of street lighting, and a by-law will probably be submitted to provide the sum of \$15,000 to purchase an electric light plant. The cost under the present arrangement is \$65.80 per lamp of 2,000 c. p.

The Kingston, Portsmouth and Cataragui Street Railway Company have assumed control of the plant of the Kingston Light, Heat and Power Company, the lease being extended over five years. The last mentioned company controlled the gas and electric light plants.

The bold enterprise shown by Canadians fairly takes a New York contemporary's breath away. The Electrical Review expresses its astonishment thus: "The Kewatin Power Company is making contracts to supply electric power in Winnipeg, Manitoba, transmitted a distance of 130 miles. Whew!"

Mr. F. W. Simmons, electrician for the Kingston Light, Heat and Power Company, has invented an operative arc lamp intended chiefly for use in theatres. It can be used either on an alternating or continuous current from 800 to 3,000 candle power, focussing electric rays from a four foot radius to eighty foot area.

Two tenders were received by the Toronto City Council for a telephone franchise. Mr. Geo. Musson, on behalf of the Automatic Telephone Co., offered to supply office telephones at \$36 per annum, and houses at \$20, and to pay a percentage to the city of 6 per cent. on gross earnings. The offer of Mr. James Curry, acting for the Wilhelm telephone system of Buffalo, was for a ten-year renewable term, and the price \$32.50 for offices and \$18.50 for residences. No action by the council has yet been taken.

The Hanover Electric Light and Power Co. have a neat electric plant at Hanover, Ont. The power used is supplied through an 81 h.p. "Kennedy" and a 71 h.p. "Barber" water wheel, developing from 275 to 300 h.p. In the power house are a 25 arc light machine, and a 1,500 incandescent light machine furnished by the Canadian General Electric Co. Besides Hanover, the villages of Karlsruhe and Neustadt are lighted from the plant, while requests for light have been made from other municipalities. Mr. Wm. Knechtel has charge of the power house, and Messrs. D. and Joshua Knechtel comprise the company.

The first case of alleged fraud with electric light meters was brought to the attention of Mr. Johnson, the Divisional Inspector of Electric Light, while in town yesterday. The meter in question had been so tampered with that it did not register, and hence the light was used without the amount of electricity consumed being recorded, and therefore with no means of ascertaining the amount that should be paid. The penalty for an offence of this kind is a fine from \$50 to \$100. Mr. Johnson has the facts before him and will decide as to what is the best course of action to pursue in the matter.—Peterborough Review.

At the annual meeting of the Montreal Park and Island Railway Company, held last month, a satisfactory report was presented, dealing with the last year's operations, and referring in hopeful terms to the work contemplated for 1897. The new board of directors was also elected as follows: Hon. J. R. Thibodeau, Hon. Louis Beaubien, Mr. D. Morrice, Mr. H. Holt, Hon. Alfred A. Thibodeau, Mr. W. Strachan and Mr. W. J. Morrice. At the first meeting of the newly-elected directors Mr. Herbert Holt was unanimously elected president; Hon. J. R. Thibodeau, vice-president; Mr. Wm. Strachan, treasurer, and Mr. H. Holgate, secretary and manager. The company's new extension to Cartierville, a three and a half miles distant from St. Laurent, and six and a half miles from the Cote St. Luc road, has been completed. Several new cars have been received from the manufacturers, the Rathbun Company, of Deseronto.

It is reported that the promoters of a large gold mine in Australia have placed an order with a California firm for a large auto-motor car for conveying supplies to the mine, located about 400 miles distant. The car will be equipped with a motor of seventy-five horse power, and will be driven by petroleum. It will be run over one of the worst stretches of desert in the world, where it is impossible to obtain either food for men or water for the automobile "beast of burden." The consequence of this is that the steam used for propulsion will have to be condensed and used over and over again. To meet this difficulty it has been arranged to place 1,000 feet of piping as a roof over the car. The piping will act as a condenser, the steam having ample time to cool in passing through its long length. The estimated speed at which the car will be run is between four and eight miles an hour, and its carrying capacity is fifteen tons.

The earnings of the Toronto Street Railway during the year 1896 were \$986,501.37. The following is a statement of earnings by months: January, \$74,266.50; February, \$74,155.76; March, \$74,409.63; May, \$83,004.13; June, \$85,175.13; July, \$87,761.37; August, \$86,103.92, September, \$106,529.57; October, \$78,444.90; November, \$76,145.73; December, \$84,310.38.

HURON AND ONTARIO ELECTRIC RAILWAY.

It is probable that the year 1897 will witness the construction of the longest electric railway in Canada, if not in America, namely, the Huron and Ontario Electric Railway. About a year ago a number of persons in Western Ontario were granted incorporation by the Dominion government as the Huron and Ontario Railway Company, the objects being to construct a railway from Port Perry westerly to Lake Huron, thereby intersecting several existing railways. The capital stock was placed at \$2,000,000, and to assist in construction the company were given power to issue bonds to the extent of \$10,000 per mile of railway, and \$6,000 additional for each mile double-tracked.

The first regular meeting of the directors was held in Toronto in May last, at which Mr. M. McNamara, of Walkerton, was elected president, H. J. Rolston, of Shelburne, vice-president, A. McK. Cameron, of Meaford, secretary, and J. M. Roberts, of Duganannon, treasurer. The second meeting was held a month later. The route of the proposed road was considered, and it was stated that negotiations had been entered into with Messrs. Miller Bros., of New York, to undertake the construction of the road. At a meeting in July, Mr. A. Brunel, C. E., was instructed to prepare a profile of the proposed route, together with a statement of the available water power and probable cost. The report was presented on August 27th, according to which the road will be 285 miles in length. The accompanying map will show the proposed route. The report divides the road into seven sections, as follows:

Port Perry to Beeton.—This line is 52 miles in length, and passes through several towns and villages. There are a number of culverts along the route, as well as several bridges, but none of them are very large. On this division there is no water power of any importance, and steam power will probably be used for the eastern portion of it.

Beeton to Flesherton.—The length of this section is 64 miles, but the road is somewhat level all the way and no engineering difficulties are likely to be encountered. The line crosses the Grand Trunk Railway three times. The first water power available is situated at Thompsonville, seven miles north of Beeton, which, with improvements, would give from 300 to 400 horse power. The dam, building and flume is estimated to cost \$8,000. At Eugenia the Beaver river has a descent of 64 feet in a distance of 2,000 feet, where there are at present four good water powers. About 1,000 horse power could be developed, while the falls below would provide a corresponding amount. Below the falls the river drops 220 feet, which would furnish a large amount of power. The basement of the Wilson factory could be converted into a power house at a small expense. In addition to the cost of the electric plant, the cost of the work is given as \$6,500.

Flesherton to Walkerton.—The distance between these two points is 37 miles. The bridging is heavy on this section, there being several large bridges over the Saugeen river. There is a water power on the Saugeen river, two miles west of Durham, which would supply 500 horse power at a cost of \$7,000.

Walkerton to Tiverton, via Kincardine.—This section is 37 miles in length, and will require the construction of a number of small bridges and culverts. The grading would not exceed the maximum of ten per cent. at any point. There are a large number of bridges, including one of 100 feet span. No report is furnished by the engineer on the water power in this district.

Walkerton to Goderich.—Between these two points the road would be 55 miles in length. From Formosa to Teeswater there would be three 60-foot and two 15-foot bridges, besides other culverts. The Grand Trunk, Canadian Pacific, and W. G. & B. division of the G. T. R. are crossed at various points. The Maitland river will be crossed by a large bridge of three spans of

145 feet each. About 200 horse power may be obtained about a half mile west of Duganannon, and on the Maitland river near Goderich there is a good site for power, capable of developing 800 horse power. The cost for dam and buildings would be from \$12,000 to \$15,000.

Bervie to Lucknow.—The shortest section is between these two points, the distance being 15 miles. It is proposed to connect the line to Kincardine at a point near Bervie with the Goderich line at Lucknow, by way of Ripley and Holyrood.

The rolling stock required for each division will be two motor cars and four trailers for passengers, mail and express, and one heavy freight motor, which would



PROPOSED ROUTE OF THE HURON AND ONTARIO RAILWAY.

give for the six divisions 12 motor cars, 24 trailers and 6 freight motors for the whole line.

The company have for some time been negotiating with Messrs. Miller Bros., of New York, to arrange for carrying out the undertaking, and it is said that an agreement has been reached with Mr. Moore, a wealthy contractor of that city, to undertake the work of construction, which they hope to have completed by the 1st of January, 1898. The total estimated cost is between four and five million dollars, and the contracts for electrical equipment, etc., will likely be awarded in the spring.

TORONTO STREET RAILWAY ASSESSMENT CASE.

THE decision in the appeal case of the Toronto Street Railway Company vs. the City of Toronto was given late in November last, and reverses the decision of the Court of Appeal confirming the assessment of \$537,137 upon the rails, poles and wires of the company. According to the decision, these are declared non-assessable. Below will be found the full text of the decision of the three judges, Messrs. J. Darnell, J. McGibbon and J. McDougall:

MCGIBBON, J.:—This is an appeal from the decision of the Court of Revision for the municipality of the city of Toronto to three judges under the provisions of the Consolidated Assessment Act of 1892 and amending Act, in respect of the Appellant's property, consisting of rails, poles and wires.

The Company contend that they were improperly assessed for \$537,137 in respect of the said property. The assessment of the Appellants for 1897 is \$563,403, and it is conceded that part of that sum, namely, \$537,137, was for rails, poles and wires of the said company. The assessment was confirmed by the Court of Revision. The question submitted for our consideration is, are these rails, poles and wires rateable property within the meaning of the Consolidated Assessment Act of 1892?

The Appellants contend that it was either personal property and exempt from taxation under section 34, sub-section 2, of the Consolidated Assessment Act—or if not personal property, was not land, real property or real estate, taxable as such within the meaning of that Act, being merely rails laid in and forming part of the streets and highways, and wires affixed to the said poles, and therefore exempt under section 7, sub-section 6, of the said act.

The classes of property mentioned in the said act, liable to assessment, are: first, land, real property and real estate, and second, personal property and personal estate.

After careful consideration of the law of assessment, I have come to the conclusion that the expressions land, real property and real estate, are synonymous terms, and that the only classes of property liable to assessment are lands and personal property, and the personal property of a railway company is exempt under section 34, ss. 2, of the said Assessment Act. The only remaining question to be considered is, "Are these rails, poles and wires land, real property or real estate, and liable to assessment as buildings erected to the buildings on the land assessed or the machinery affixed?"

It cannot be contended that either the rails, poles or wires are real estate, but only become so when they become affixed to the land and form a part thereof, and would be saleable under a tax deed for arrears of taxes.

In the case of Toronto Street Railway Company v. Fleming, 37 U. C. R. 116, Patterson, J. A., page 127, says, "The property of these defendants is only land as being part of the public street." The streets

remain "public streets" if the soil of the streets is exempt; I find nothing in the Act to say that that portion of it is not exempt which is occupied by the Plaintiff's railway while still remaining a part of the public road.

In my opinion the rails, poles and wires are not buildings erected upon or affixed to the land of the company, or machinery or other things affixed to any building erected on the said land under sub-section 9, section 2, of the said Act. The rails are laid on and fastened to the superstructure which is attached to the road or street, and are in no way attached to the land, real property or real estate of the company; so likewise are the poles and wires.

If the rails, poles and wires are attached to any land, they are attached to the roadway or street and form part of the same, and therefore exempt under section 7, sub-section 6, of the Consolidated Assessment Act.

It is contended by the Respondents that the Appellants are occupants of the street, and their property, therefore, liable to taxation. I do not think the Appellants have such an occupancy independently from the Respondents as to say that the Respondents have parted with their official occupancy and given it to the Appellants, and that the Appellants are liable to be taxed for the said streets under the said sub-section 2 of section 7 of the Assessment Act. The Respondents do not part with the occupancy of the streets, but retain possession of the same, merely granting to the Appellants certain rights and privileges, and the Appellants cannot be considered the occupants under section 2 of section 7, and liable to assessment. The streets remain the property of the Crown under the jurisdiction of the municipality, and they are exempt from taxation, as also are the rails, poles and wires of the Appellants when affixed to the said streets; ss. 1 of section 7 of the Assessment Act.

I do not think the decisions in the English rating cases are applicable to the present case. The difference in principle is shown in the judgment of Barton and Patterson, J. J. A., and in the case of the Toronto Street Railway Company v. Fleming, 37 U. C. R. 116. I do not consider the assessment law has been materially changed since the decision in the Fleming case so as to affect this case. The sections are now, with the exception of a few trifling verbal changes, the same as they were when the Fleming case was decided. I cannot distinguish this case from the Fleming case, in which it was held that the railway company was not assessable for these portions of the streets occupied by them for the purpose of their railway, as being land within the meaning of the Assessment Act of 1869. This case is distinguished from the Consumers' Gas Co. v. Toronto in that the pipes and mains of the gas company were laid in the city streets and attached to the plant and buildings of the company, whereas, in the case under consideration, the rails, poles and wires are in no way connected with the power house, plant or buildings of the Appellants' company.

I hold this case to be covered by the decision in the Fleming case, and would therefore allow the appeal with costs.

I am well satisfied to arrive at this conclusion because the city and the company entered into their agreement, 55 Vic., Chap. 99, on the faith of the law settled by the Court of Error and Appeal in the Fleming case, and it would be, in my opinion, inequitable for the city by an assessment of the railway in the streets of the city, to increase the liability of the Railway Company under the agreement.

DARTNELL, J. — The matters in question before us are of the highest interest and importance to the parties concerned, and require the most careful consideration. There are no contested facts in dispute, no evidence having been offered, and such facts as are necessary for consideration are fully set out in the arguments of counsel for each side, and the documents, papers and authorities submitted to us.

What we have to consider is whether, under all the circumstances submitted to us, is the Toronto Street Railway Co., for the remaining 25 years of this franchise, liable to taxation in respect of their rails, poles and wires erected and being upon the city of Toronto. It is conceded that for the first time since the agreement between the city and the company entered into some five years ago, and which has received legislative sanction, the city has undertaken to assess the company for the property now in question, and which has heretofore escaped taxation.

It is also considered that such a taxation for such 25 years will amount to a sum aggregating in the whole to about \$300,000.

The city, apparently acting on the assumption or belief that the case in the Court of Appeal of the city of Toronto and the Consumers' Gas Co. has practically modified, distinguished or overruled the case of Fleming vs. Toronto Street Railway, conceived that the latter case was no longer binding upon them, and undertook for the first time to impose a rate upon the property of the company, now the subject of appeal.

These two judgments leave the state of the law in a somewhat unsatisfactory condition, arising from the fact that the judgments of the members of the Courts are not unanimous, and those judges who have arrived at conclusions which unitedly are the framework of the decision of the Court, have reached such conclusions by devious ways.

Since the case of Fleming vs. Toronto Street Railway has been decided, the verbiage of the Assessment Act has been altered, and in that respect, the authority of that case as applied to the question before us is somewhat weakened. But for this, I should be inclined to hold that we were concluded by that case, and should without question allow the company's appeal.

I humbly conceive that there is a marked difference between the position of the gas company and the railway company. The former company is essentially a commercial corporation having an article of commerce to dispose of, which has been ranked in our courts as a "mineral," which can only be distributed to the company's customers through pipes connected with their main works and the storage reservoirs containing the commodity they sell. The general public have no interests in the works at all analogous to the use of the public highway and can at will put an end to the contracts made with their customers, subject, of course, to the ordinary rules governing all contracts. The railway company, on the other hand, offers to the city an improved and convenient method of utilizing the highways of the corporation, and undertake to do for the city what the city itself has power to do without their intervention. The city has surrendered to them certain portions of the surface of the city highways, for the greater ease of the propulsion of their vehicles, giving them the legal right of way over other vehicles,

and the right of exacting toll from the passengers using such vehicles, and exacting as the price of such concessions a mileage rental or assessment and a percentage of the gross profits of the company. They are common carriers, and are bound to receive all passengers presenting themselves for carriage and to keep in constant good condition their whole system. They also perform other services for the city, such as street watering and the conveyance and dumping of city garbage and refuse. In these respects the positions of the gas company and the railway company are essentially different. I am clearly of opinion that the relationship between the city and the company is not that of landlord and tenant. It is rather that of licensor and licensee. In fact the agreement between the parties ratified by legislation explicitly treats and styles them as "vendors" and "purchasers." No weight whatever can be given to this argument.

Neither do I think that this railway can be treated as a railway company in the sense that the C. P. R. or the G. T. R. or any railway incorporated under Dominion or Provincial authority can be classed as such, and entitled to exemption from taxation in respect of their rails as part of their superstructure. They have never taken that position until now.

I have carefully considered the discussion, arguments and judgment in the case before the Privy Council of the Queen vs. the Toronto Street Railway. I do not consider that the effect of that judgment is to declare that the latter is a "railway" in the sense that a Dominion or Provincial railway is a railway. It simply decides that certain rails imported for use and to be laid on the company's "railway track" and being over a certain weight, were exempt from customs duty.

I have had the advantage of the perusal of my brother McDougall's able and exhaustive judgment. He has so fully gone into the historical part of the subject, and so fully collected and set forth all the authorities bearing upon the matter, that it would be superfluous on my part to endeavor to supplement his remarks, even if I were able to do so. I may be permitted to remark that the English authorities, however instructive and illustrative, are not altogether binding upon us, inasmuch as the method of rating in England for the purposes of taxation is essentially different from our own. There the question before the courts is "Is this a bona fide occupancy?" and the occupant is rated. In Ontario the property is rated and is primarily liable. The question of ownership is entirely subsidiary.

I agree with my brother McDougall that the poles and wires of the company are governed by the ratio decidendi in the gas companies' cases as being the vehicle by which the generating power is conveyed from the power house. I think that they are so intimately connected with the source of motor power as to become as much really as say a shaft drawn by a central machine, or a cable laid along or under the public streets. I think the rails, if utilized for conveying the current to the motors, or after the expenditure of its force on the motors, returning it to the power house, in other words, completing the circuit, would be assessable, but if such circuit could be completed without the aid of the rails that then the rails would not be assessable, because they would form part of the highway constructed and used for the purpose of more effectually and rapidly furnishing the paramount object highways are established and maintained for, namely, rapid, convenient and efficient transit and traffic.

To illustrate my view as to the non-assessability of the company's rails, I would suppose the not unlikely case of the city, instead of constructing, maintaining and keeping in repair the public streets of the city, had, under contract with some construction company possessing the right to use some new or advantageous form or method of street paving, employed them for a consideration to do this work at an annual rate for a term of years; would it be just, equitable or fair for them to seek to diminish the price they have engaged to pay by an assessment upon the value of the material used in the construction of the pavement? I submit that the difference between that case and the use of the rails of this company for the greater ease of traction is only one of degree.

The judgment of the Court of Appeal in the gas case, in which the gas mains and pipes were held assessable, proceeds largely upon the assumption that those mains and pipes are, as Mr. Justice Rose expressed it (23 A. R. at page 556) "liable to taxation as part of the property of the company, increasing the value of the building and plant." It could not well be held otherwise, for the special case submitted to the court expressly states that these mains and pipes "were attached to buildings and plant of the company." Unless the use of these rails for this company for the purpose of transmitting the motor power can be said to attach them to the plant and buildings of the company—to my mind they are entirely detached, and are personable property and are non-assessable. It is not essential that this company should use this current in this particular way as a motive power. They could use it in another way by erecting a return wire, discarding the current by means of the rails, or they could establish storage batteries or motors driven by compressed air, or by other means which the advance of science is so constantly suggesting.

I have perused the report of the New Brunswick case cited to us and am not convinced that it is an authority binding upon us. I have considered the effect and the meaning of the references to "tax" in the agreement of the contracting parties. To my mind it does not refer to more than such taxes as were no doubt impossible upon such property of the company as is not placed upon the streets of the city, the use of which was the franchise which was the subject matter dealt with. The company would require other property, such as their power-house. They would have to erect or rent office buildings, waiting rooms, car stables, etc., and might require space, buildings and machinery for the construction of cars, etc. The reference to these transactions was wisely inserted in the document for the purpose of avoiding any difficulty which might arise as to the disposition of these taxes between the public and the separate schools.

This brings me to the consideration of the concluding argument advanced by the company against the imposition upon them of these taxes, viz: That to do so is to import into the agreement between contracting parties a new and onerous condition or stipulation which was never in the contemplation of the parties to the contract at the time of its execution; which it would be inequitable to enforce, and which cannot be evolved from the four corners of the document as it stands.

Corporate bodies are bound by the same rule of law and conduct as individuals. Their component parts are variable, but the corporation continues to exist as a whole. The city may change its policy or reserve its former action, but it must always be held to its contracts and agreements entered into previous to such change or reversal. The agreement between these two contracting corporations was the outcome of a contest between men of keen business and legal acumen, and after the fullest and most prolonged discussion the result was embodied in the pages of this document. These parties had before them the judgment of the highest courts of the province declaring that this very property of this very railway is not liable to taxation. Because, since that decision, a change has been made in the verbiage of the Assessment Act, and the authority of such decision by a subsequent judgment is supposed to be weakened or impugned ; because " Another thing has arisen which knew not Joseph "—I ask you why the parties should either be relieved from obligation or have another onerous one imposed upon them ? I humbly conceive not. If the legislature to-morrow passed a law declaring that the rails, poles and wires of all street railways are liable to taxation, I do not see how the position of this company would be effected, unless it was declared that such legislation should be expost facto. This might be confiscation, but it would have to be obeyed. I think this corporation is endeavoring to filch with one hand what they have given with the other.

I have considered the point whether this tribunal has any power or authority to determine more than the question whether this particular kind of property or any part of it is liable to taxation or not. In my opinion, to do so would be "Academic" only and would not be a binding value, or such a determination or finding that the contestants are entitled to. This court is one of review upon the proceedings upon a body of men composed in all urban and rural municipalities except the city of Toronto of all, or the greater part of, the members of a corporation, one of the litigants. It is meant to be a check upon their proceedings and is given power to redress a wrong when a wrong has been done. If this corporation, after granting an exemption from taxes, had undertaken to assess and levy taxes, contrary to such an agreement, the Courts would quickly interfere and restrain them. I think this Court would have equal authority.

With great diffidence I venture to place on record my opinion that (save in so far as my judgment agrees with that of my brother McDougall) the judgment of the Court of Revision should be reversed with appropriate costs to be paid out of the fund paid into the City Treasurer to cover the costs of appeal.

McDUGGALL, J. — The first question I propose to consider is as to whether street railways came within the purview of sec. 29 of the Assessment Act; because if they do so the superstructure is not to be assessed, under several decisions in our own courts. In *City of Toronto v. The Queen*, 168 *Q.B.* 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 90

The next important matter to be considered is the effect of the decision in the Court of Appeal of the Toronto Street Railway v. Fleming, 37 U.C. 116. A judgment in that case was pronounced in 1875 upon the clauses of the Assessment Act as they stood at that date. See, sec. 3 of 32 c. 10, cap. [38 Ontario, 1869] re d. (3) and (4) of the Act of 1869, which provided that "all buildings, erections, and other things erected upon or affixed to the land, and all machinery or other things so affixed to any building as to form in law part of the realty, and all trees or underwood growing upon the land, and all mines, minerals, quarries and fossils in and under the same, and all rights and franchises, and all rights and interests in and to the same, and all personal property include all goods, chattels, share, incorporated companies, interest on mortgages, dividends from bank stock, in ex. note, accounts and debts at their actual value, income and all other property except land and real estate and real property, and all rights and franchises, and all rights and interests in and to the same, and all personal property include both real and personal property as above defined." See (6) "All land and personal property in the province of Ontario shall be liable to taxation, subject to the following exemptions, that is to say:— 'Now, in the Act of 1869 the sixth clause of the foregoing is transposed, and becomes sub-sec. 4 of sec. 4 of the sixth chapter of the Ordinance of 1875. The word 'land' in the clause includes both real and personal property as hereinafter defined.' Sub-sec. 4 takes the place of sec. 3 and reads: 'Land, real property and real estate shall include,' etc., following the exact words of the old section, with the addition of the words 'and land' covered by the word 'land' in the place of the word 'land' in the old section. The importance of the importance of this appeal. See, sec. 9 of the Act of 1869 has an important change

made in it, and become sec. (7) in the Act of 1892, and reads now as follows: (7) "All property in this province shall be liable to taxation subject to the following exceptions, that is to say: 1. The first appeal to be noticed is the passage in the judgment of the Exchequer, J., in the case of *St. John's Railway v. Fleming*, at p. 126, that "If there was a general law that all property in the province was liable for municipal purposes, I should have no hesitation in deciding that this was assessable property. The question, however, is: Is it assessable as land?" Mr. Patterson then proceeds to argue that, as, in the exemption clauses, sub-sec. 6 exempts every parcel of land, and sub-sec. 7 exempts every parcel of land, it is necessary in respect of the portions of the streets used for the purposes of the railway, and not only land that can be assessed, they are not liable, because all the land in the public roads is exempt." Upon reference back to the case stated in Toronto Street Railway v. The Corporation of the City of Toronto, 35 O.R. 126, it will be seen that the controversy there and the assessment of alleged claim for taxable liability were under consideration, in order to contrast it with the subject-matter of this appeal.

Paragraph 2 of the stated case shows this put clearly, and reads as follows: "The assessment for the said taxes in regard to which the said distress was made by the defendant was made by the city of Toronto in respect of the portions of Queen street, Yonge street and King street used by plaintiffs for the purposes of their said railway under the provisions of the Act, statutes and by-law hereinafter referred to." The present appeal is against the assessment of the company under the head of lands, buildings and improvements, and in the column headed "Value of Buildings and Improvements" the disputed assessment appears as follows:—

VALUE OF BUILDINGS AND IMPROVEMENTS

of \$ 4,000

(§537,137—rails, wires and poles used by the company in connection with the said lands for the purpose of operating its railway in and upon the lands of the company or the streets of the city.

What this appears to mean I take it, is: rails, wires and poles used by the company, placed on the lands of the company or on the streets of the city, which said rails, wires and poles so placed as aforesaid are used by the company in operating their cars and street cars, and the use of the same by the company in operating their Consumers' cars v. Toronto that the gas mains laid in the public streets beneath the surface are assessable, notwithstanding the existence of sub-sect. 6 of the exemptions (act 27) of the City of Toronto. The Chancellor, in his judgment in the same case, at Ont., page 722, says (act 27) "the gas mains are not to be assessed, as they are not to be considered as being carried above or underneath the soil of the highway." In the Electric Telegraph Co. v. Overseers of Salford 11 Exchequer, 181, the Court gave effect to the legal definition of land as including not only the face of the earth, but everything on it or over it, and said that the gas pipes were not to be assessed, as they were not to be considered as being carried above or underneath the soil of the highway. The same rule shall include such and such meanings—not that all other things not covered by the word shall be excluded. In *Pimlico Tramway Co. v. Greenwich, L. K. G. Q. B.* p. 9, the company was held to be rateable as occupants of the highway by reasons of the fact that the gas pipes were not laid in the exclusive occupation of the company, but the use of the surface of the track, that being in the exclusive occupation of the company, of the soil, as they were in laying their tracks in the same, they were liable.

Lord Blackburn, at page 14 says: "There is a considerable resemblance between the iron tram rail or artificial tramway here and the pipe which is laid down, though there is this difference, undoubtedly, that the pipe (I do not know that it would be necessary if it should be so) is generally buried in the soil some way below the actual pavement or macadamized road which forms the thing actually supporting the carriages passing along; but I do not think that makes any difference."

Lush, J., said : " I am of the same opinion. The Act of Parliament enables the proprietors of a tramway to appropriate to their own purposes a given portion of the public road for the purpose of laying down the tram rails which are requisite for the conveyance of their carriages along the line of road. The tram rails occupy a portion of the roadway exclusively used by the tram rail company for the purposes of the tramway, and that, I think, is all that can be occupied as that portion of the soil. I do not think they are the less occupiers because the public as well have the right of way over the surface of their iron road; and the road, as a common, is in their exclusive use, and used for their exclusive benefit."

Quinn, J., said he was unable to distinguish the case from the cases which had been decided on the occupation of land by water companies and gas companies. At page 10 he says: "It appears to me that no difference can be pointed out between this case and the cases of the water and gas companies, which are decided upon a deeper in the soil than this iron tramway." Again he says: "I am unable to distinguish the iron tramway from the gas and water pipe. Both physically occupy the same space, and both are laid at the same level, the rail having the upper surface level with the road, but they both occupy the full of the same physical space in the same manner do not see either in sec. 57 or sec. 62 any provision which in any way interferes with that principle. They only preserve the right of the public to use the road, and the right of the owner to use the soil beneath the road, and the baulks of timber upon which they are laid, were part of the road in the sense of being the property of the public authorities." They remained the private property of the owner, and the baulks of timber upon which they are laid, and the baulks of timber are occupying the soil of the road in the same manner as the water pipes and water pipes; and the latter being rateable, I think the former are also, rateable.

I have quoted at so much length from this instructive judgment because I think its language is equally as applicable to the questions in issue in this appeal. The position of the tracks, inlets and the railway crossing is shown in the plan annexed to the report. It is clear from that position of gas mains buried under the soil. The street railway has exclusive use of their rails and of the soil occupied by their rails and ties for the purposes of their business. It is true that the public can drive over and along these rails and ties, but they are not to be used for any other purpose than to run the streetcar to the pavement to enable vehicles to do so; and they are not to be used, in any way, except the mere surface of the rail. If gas mains are assessable, I am firmly of the opinion that these rails and ties are, with so much of the soil as is used therewith, as the streetcar company, and in this respect assessable. As to this underground soil surrounding the rails and ties, it is not assessable, because it is not used for any purpose within the meaning of the Assessment law of Ontario. This conclusion is supported by the last cited English case of *Fimlico v. Greenwich*, and by the Consumers-Gas Company v. Toronto, 26 Ont. 722, and by the judgment of the Court of Appeal in the *London & North Western Ry. Co. v. Ingham*, 12 App. Cas. 513. The word "land" as used in sec. 9 in the Assessment law, means the soil, the ground, and, especially by the change to the word "property" in sec. 7 of the Assessment Act of 1852.

As to the rights of the public, they are subordinate to the rights of the company, who have the right of way in preference to the public; the public must give way to them, to their cars, and to the tracks and rails. In *Helwell Union v. Hellyn Drainage Co.*, appeal cases 1895, page 127. In the last case, the right of the public to the street which is approved. The wires and poles in use by the Toronto Street Railway Co., to my mind, are also undoubtedly assessable on the principle defined by the case of the Gas Consumers v. Toronto, as being in precisely the same position as the gas mains, in the air over the highway instead of being buried in the soil, and the wires, posts and poles, are in the same position as the gas pipes, and there is an unbroken connection with the power house of the company. Through them the electric current is carried along the whole system of the street railway to move their cars. Like the gas mains, they, thus united with the machinery in the power house, form one feature with it, and it is one indivisible plant. They have the exclusive use of the street, and the street is theirs. The poles and wires are not in the street, but on the surface of the street—have no joint or even subordinate rights to the poles or wires overhead. I refer to *Lincolnshire Telephone Co. v. Manchester*, 13 Q. B. D. 780 and 14 Q. B. D. 297 in appeal; *The Electric Telegraph Co. v. Selford*, 11 Exchequer 184; and the case of the Consumers' Gas Co. v. Toronto, 20 Ont. 222 and

[illegible]

surface railways in the city of Toronto. Now, two things are dealt with: The property, tracks, equipment, stock, plant and real estate acquired by the city from the old Toronto Street Railway Co. This was sold absolutely to the new company. Next, the franchise to operate, for a limited time, surface railways is conferred. The property, or the portion thereof here sought to be taxed, was sold outright; but the franchise or privilege to operate a surface road was conferred for a term only. What is sought to be reached by the present assessment, to be taxed, is the property, not the franchise. That there was a sale is made more manifest by turning to sec. 4 of the Act of Incorporation of the Toronto Railway Company, sub-sec. 2 and 3, where it is declared that if the city did not renew the franchise at the end of thirty years, and desired to take over the property, they are to pay the company therefor at a valuation to be determined by arbitration; and it is expressly declared that they are not to pay for the franchise.

Mr. Osler also urged that as the title of the highways upon which these rails are laid was vested in the Crown or in the municipality under section 525 and 527 of the Municipal Act, no portion of the soil is therefore taxable lands so vested being exempt. Sub-sec. 1 of sec. 7 of the Assessment Act reads: "All property vested in or held by Her Majesty, etc., is exempt"; but sub-sec. 2 of the same section declares: "When any property mentioned in the preceding clause is occupied by any person otherwise than in an official capacity, the occupant shall be assessed in respect thereof, but the property itself shall not be liable." Similarly, municipal property by sub-sec. 7 is declared to be exempt whether occupied for municipal purposes or unoccupied, "but not when occupied by any person as tenant or lessee, or otherwise than as a servant or officer of the corporation for the purpose thereof." The land is liable to be assessed, and the occupant made liable for the taxes.

I think, in view of these provisions, and of the conditions of purchase by the Toronto Railway Company, they can not be deemed to be tenants of the city, but are owners of the tracks and plants, and are occupants of the streets, whether said streets are vested in the Crown or in the municipality; and as such occupants, they are liable to taxation, though the land itself, and as such occupied, is not liable for the payment of said taxes. The fact that under sub-sec. 2 of sec. 7 exemption clause, a special liability is created against an occupant of Crown or municipal lands to pay taxes in respect of such lands and of such occupation, develops a taxable responsibility almost identical with that existing in England, and hence decisions in the English courts upon this point are germane and cogent in determining questions arising in reference to this class of ratepayers.

I have already pointed out that so far as my opinion is concerned, I am unable to

distinguish any difference in liability between the owners of street car tracks buried in the soil twelve or eighteen inches, and the owners of gas mains buried four or five feet beneath the surface in the same street. The Court of Appeal for this province, by its latest decision upon the same sections of the Assessment Act, as now amended, has held that gas mains are assessable. In the present case I think I am justified in following the principle of the latest decision upon these troublesome sections of the Assessment Act. I feel less hesitation in doing this as the case of the Consumers' Gas Co. v. Toronto is now pending before the Supreme Court; and we are given to understand by counsel at the argument of this case that any judgment pronounced by this court would in all probability be taken for review to the same court of last resort. I hope this will be done, and the many conflicting opinions expressed by our ablest and most distinguished judges be finally reviewed by the highest court of the Dominion, and these vexed questions authoritatively disposed of.

I have only had the opportunity of seeing the judgments of my learned brothers a few minutes before coming into court. I cannot adopt the reasoning of my learned brother Darnell that the corporation of the city of Toronto are not justified in making the assessment complained of in this appeal because such taxation adds a term or burden to the agreement entered into in 1831 between the city and the Toronto Street Railway Co. The agreement itself does not purport to deal with the matter of taxation. The question of liability to taxation of a species of property must depend upon the Statutes in force from time to time in the city's behalf. If the property in question in this appeal is assessable under the Assessment Act, no bargain or agreement, express or implied, made between the city of Toronto and the Street Railway Co. to exempt it from taxation, can have any effect unless sanctioned by the Legislature. No such sanction is claimed or shown, I venture to think, that the sole duty of this Court is to interpret the meaning of the taxing clauses of the Assessment Act and to determine if the property assumed in this case is taxable property under the terms of section 7 of the Assessment Act, qualified by the exemption clauses of the same section. I can find no authority in the Assessment Act to enable us to administer so called equity, and to declare that although we may be of opinion that the property here sought to be taxed is legally liable, yet that it is unjust or inequitable to affirm such assessment because at some antecedent period when one or even both of the parties to a bargain or agreement incorrectly concluded that the class of property now sought to be assessed was not under the existing law liable to assessment and taxation.

The appeal was allowed with costs, McDougall, J., dissenting.

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VOL. VII.

MARCH, 1897

No. 3.

MR. W. H. BROWNE.

A PERUSAL of the somewhat lengthy address, printed elsewhere in this number, delivered on the occasion of a visit of inspection to the works of the Royal Electric Company, Montreal, will serve in a measure as an introduction to the manager, Mr. W. H. Browne, a capital portrait of whom appears on this page. Scarcely more than two years has elapsed since his acceptance of the position of head of one of the largest electrical manufacturing concerns in Canada, yet through his energy and ability the company have been compelled to greatly enlarge their plant, and to-day they possess a modern factory in every respect, with a plant valued at \$2,500,000, and employing 500 workmen.

Mr. Browne was born under the American flag in the year 1849, his birth-place being Troy, N. Y. When only seventeen years of age he was attracted to the city of New York, where he engaged in the foundry and general hardware manufacturing business. The mechanical as well as business experience thus obtained formed the foundation of his future success, as, in addition to being afforded the opportunity of perceiving the possibilities of the electrical field, he was brought in contact with some of the leaders of commercial and industrial enterprise in the American metropolis.

Besides investing in other electrical enterprises, Mr. Browne became interested in and was one of the organizers of the Richmond, Va., electric railway, which was the first electric railway in the United States, and was commenced in the year 1888. He continued as manager of this road and its lighting plant until 1891, but in addition received the appointment in 1888 of manager of the United Electric Light and Power Company, perhaps the largest concern of the kind existing at that time, which afterwards absorbed the United

States Illuminating Company and the Brush Illuminating Company. Mr. Browne has occupied his present position since January, 1895, and during the past two years the company have met with marked success.

THE BELL TELEPHONE COMPANY.

THE seventeenth annual meeting of the shareholders of the Bell Telephone Company was held in Montreal last week. The annual report presented showed that 653 subscribers had been added during the year, the total number of sets of instruments earning rental being 29,462. The company now owns and operates 341 exchanges and 275 agencies.

There were 176 miles of poles and 1,013 miles of wire added to the long distance system in 1896; of these 11 pole miles and 236 wire miles are in the Ontario department, and 165 pole miles and 777 wire miles in the eastern department.

The long distance lines now owned and operated by the company comprise 15,864 miles of wire on 6,060 miles of poles. The new building in Montreal is nearly completed, and will be ready for occupancy in May. The new building in

Winnipeg was completed last November.

Mr. John Crawford expressed a doubt as to the advisability of extending the long distance service. He did not consider it as profitable as the short distance.

The annual report was adopted and the old board of directors unanimously re-elected, which terminated the proceedings.

E. S. Jenison, of Port Arthur, Ont., proposes to utilize the water power of the Ecarte Rapids and Kakabeka Falls, on the Kaministiquia river, for light and power purposes, and is seeking authority therefor from the Ontario government. Moss, Barwick & Franks are acting as solicitors.



MR. W. H. BROWNE, Manager Royal Electric Company.

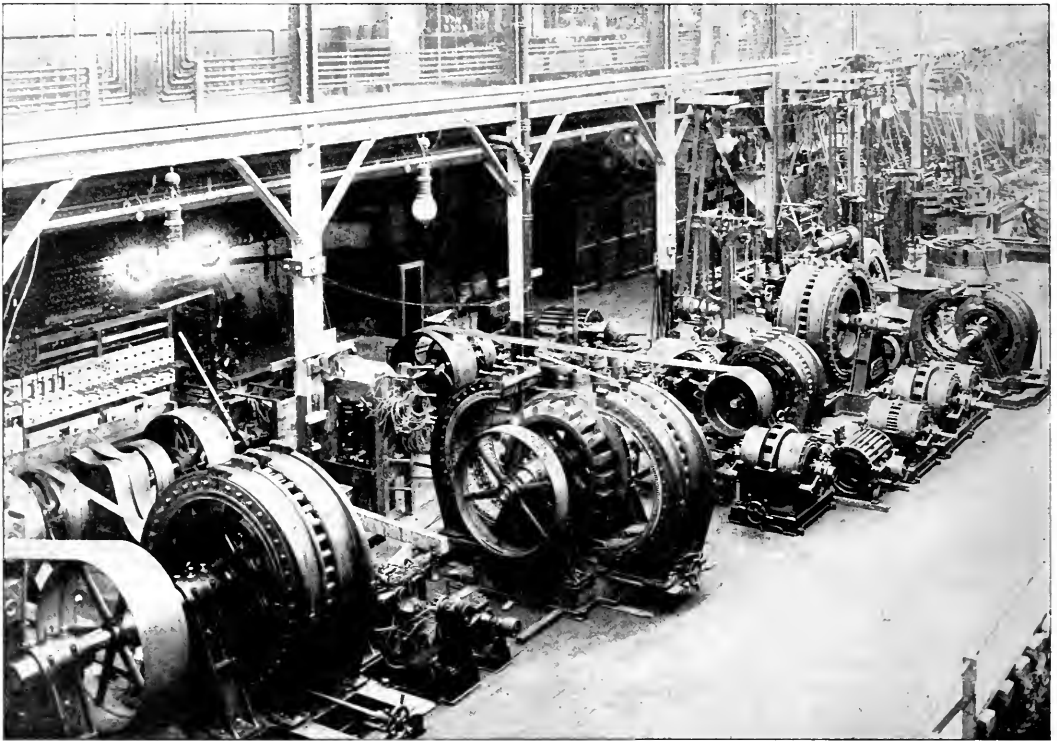
THE ROYAL ELECTRIC COMPANY.

In response to the invitation of the above company, a large number of persons, comprising shareholders and men prominent in the various walks of life, gathered in Montreal on the 10th of February for the purpose of making an inspection of the company's generating station and manufactory. In point of arrangement and equipment this station and factory are claimed to be representative of the most modern practice, and therefore offer a valuable object lesson to the visitor.

The following persons connected with the electrical interests were present, in addition to a large number representing the various branches of commerce as well as the professions:

Mr. F. H. Badger, Manager Montmorency Electric

The works were gaily decorated with flags, and on the second floor of the generating station was spread a tempting luncheon. Here the visitors received a hearty welcome from the President of the company, the Hon. Senator Thibeaudeau, who in his concluding remarks introduced Mr. W. H. Browne, the general manager of the company. Mr. Browne spoke at some length, outlining in a very able and interesting manner the development of the company's enterprises from their earliest beginnings. Mr. Browne's remarks, printed in full below, will repay careful perusal, as showing the wonderful strides in the direction of development and improvement which electricity is making in the Dominion. Canada has not been content merely to keep abreast of the times, but is actually proving herself to be a



VIEW OF ROYAL ELECTRIC COMPANY'S FACTORY, MONTREAL, SHOWING APPARATUS RECENTLY COMPLETED.

Power Co., Quebec; Jules Bourbonniere, Manager Imperial Electric Co., Montreal; W. J. Camp; A. A. Dion, Superintendent Ottawa Electric Co., Ottawa; Ormond Higman, Chief of the Electric Light Inspection Department, Ottawa; W. Munderloh, of Messrs. Munderloh & Co., Montreal; L. B. McFarlane, Supt. Bell Telephone Co., Montreal; R. E. T. Pringle, Montreal; Fred. Thomson, of Messrs. F. Thomson & Co., Montreal; J. J. Wright, Manager Toronto Electric Light Co.; Prof. Carus Wilson, Electrical Department, McGill University, Montreal; Edward Carter, St. Johns Elec. Co., St. Johns, Que.; H. O. Fisk, Supt. Peterboro' Light and Power Co., Peterboro', Ont.; J. M. Fortier, Pres. Imperial Electric Light Co., Montreal; Jas. H. Howry, Packard Electric Co., St. Catharines, Ont.; J. A. Kammerer, General Sales Agent, Royal Electric Co., Toronto; E. A. Lacroix, North Shore Power Co., Three Rivers, Que.; W. S. Shaw, Shaw Electric Co., Montreal.

pioneer in electrical progress, both in relation to lighting and power. Mr. Browne spoke as follows:

GENTLEMEN,—To the citizens of Montreal the Royal Electric Company is well and chiefly known by the brilliant illumination which provides the security of daylight to the streets and parks of the city.

It is also known by the cheerful radiance of the numerous incandescent glow lamps, which makes pleasant and decorate so many residences and places of business.

As a manufacturer of electrical machinery and apparatus, it is, however, better known throughout the Dominion of Canada than in the city of Montreal.

It has been manifest on several occasions that many, even of those who are intimately acquainted with the company, have very little actual knowledge of the extent and character of the source of the illumination they enjoy and have a very inadequate conception of the enterprise represented by, or the establishment constituting the Royal Electric Company.

To those throughout the Dominion, who are users of electrical appliances, the company is well known as manufacturers of the best and most advanced type of such appliances, and in a general way as conducting the largest electric light and power plant in Canada, but the full extent of this feature of the business is not thoroughly comprehended even by those who purchase and use its manufactures.

The completion of recent improvements made in the generating station, and of the equipment of the new factory in full working

order, and at work in the manufacture of large apparatus, has, therefore, been deemed an appropriate occasion to bring to the personal knowledge of the citizens of Montreal and to those throughout Canada, who are interested in electrical enterprises, the fact that in the Royal Electric Company the city of Montreal and the Dominion of Canada possess an industrial institution of the highest rank.

We have believed that it would be an especial pleasure to you to become acquainted by actual inspection with the details of an electrical manufacturing establishment within your city and country, which in character of machinery and equipment employed in adaptability to its purpose, and in quality and finish of product, is the equal of any on the continent—second to none.

We have also believed that it would be to you an equal pleasure to see in operation a generating station unique in many particulars, far in advance of stations even in the largest cities, and containing features which are models and standards to which others will conform.

This is the object and purpose which actuated the president and directors of the Royal Electric Company to extend the invitation, which your presence indicates was agreeably acceptable.

The factory and station you have seen to-day represent the utmost development attained to the present moment in the electrical

Wellington streets was leased and became the factory, lighting station, stores and offices of the company.

In July, 1886, the streets of Montreal were first illuminated, 113 lights being placed; to-day nearly 1500 lights in the streets render your city one of the best lighted on the continent.

In 1888 the first incandescent lights were supplied, and a dynamo having the capacity to provide 500 lights was installed. The station which you have just inspected has connected with it and serves at present about 65,000 incandescent lights, besides electric motors and arc lights and is capable of supplying 50,000 more.

In 1889 the generating station, known as the East End station, on Water and Commissioners' streets was established solely for arc lighting.

In 1891 the building in which you are at present was built and equipped as a generating station to meet the rapidly increasing demand for incandescent lights.

In 1892 the first electric motor circuit was established.

In 1893 the evident extensive field available in Montreal for the application of electric current directed the attention of the company to the utilization of water power. After an exhaustive examination of all water powers contiguous to Montreal, and after a most thorough comparison of the merits and demerits of each



VISITORS VIEWING THE FACTORY OF THE ROYAL ELECTRIC COMPANY, MONTREAL.

art as applied to light and power purposes and also represent the development and growth of the Royal Electric Company, which has kept pace with the progress of electrical science.

From a beginning in 1884, with a dynamo of 12 light capacity, a work room containing a few ordinary machines, shop tools, a dozen employees, and a capital of less than \$50,000, it has steadily and continuously progressed, so that to-day its generating plants provide electric current for street lights, house lights and motive power to the equivalent of 100,000 16 candle power incandescent lamps, with capacity for 50,000 more; its factory is equipped with the latest and most modern machinery capable of building the largest electrical machinery used in the world, and is now actually at work manufacturing generators of each nearly 3000 horse power capacity; has nearly 500 employees and possesses plant representing \$2,500,000.

It introduced in 1884 a new business in Canada beginning with the manufacture and use of what was then the best and most improved electrical apparatus and continued to be the leader in its line.

To-day it is manufacturing and using generators and other electrical apparatus which are so far superior to those hitherto or elsewhere made in Canada as to be considered, even in the electrical world, a new departure, the improvement is so radical and far reaching.

The company began business in 1884, having both its factory and generating station in a small building in Down street.

In September, 1885, the building on the corner of Queen and

as applicable for electric light and power purposes, all were rejected except that of the Richelieu rapids at Chambly, the rights to which were secured by the company.

In 1894 the building at the corner of Wellington and Queen streets, which in 1885 was more than sufficient for all the purposes of the company, was found to be inadequate for the manufacturing purposes alone, and plans were prepared for the erection of a new factory building, so that the factory equipment could be placed therein by the expiration of the lease of the former building on May 1st, 1895.

In 1894 also the desirability of a greatly improved line of electrical apparatus and the opening of new fields for such apparatus resulted in a contract agreement with the Stanley Electric Manufacturing Company of Pittsfield, Mass., for the sole right of manufacture and sale in the Dominion of Canada of the apparatus which they had a short time previously introduced in the United States and which almost immediately assumed first rank as electrical machinery and was recognized by all, who were competent by experience to judge, as being vastly superior to any which had been hitherto produced, and possessing features entirely unknown to the old style of apparatus, features and character of construction which placed it as far beyond all that had previously been made as the marine engines of the ocean liners of to-day are in advance of the ordinary stationary engines of 50 years ago.

This apparatus, known and designed by the initials of the names of its joint inventors and designers, Messrs. Stanley, Kelly and Chesney, being capable of supplying from the same machine and

from the same wires, incandescent lights, are lights and motors, occupied a new field and made profitably possible the extension of electrical business in directions not hitherto commercially available.

It also occupied a new field, for instead of being the cheap temporary method of construction characteristic of earlier electrical machinery, it is built in the very best manner, equal in every particular in finish and character of manufacture to the best machinery in every other line of commercial practice.

The S. K. C. generators completely revolutionized the method of construction and operation theretofore employed. The particular feature, which in all other generators is the source of constant annoyance, expensive and frequent repairs and loss of service, namely, the revolving wire wound mass known as the armature, with its complicated commutator and constantly wearing and fire emitting brushes, requiring the closest attention of employees and numerous devices for operating and regulating was entirely abandoned and instead is employed simply a solid steel wheel, having contact with no other part and having no wearing or contact surfaces except the journal bearings. To the electrical operator this feature alone was a long coveted boon and is a source of constant delight. To the owners it is a source of great economy and increased net revenue. The record and date of these generators is that the maintenance and repair account has been reduced to nothing.

The S. K. C. system employs the simplest method of what is known as the polyphase system, the development of which has made possible the transmission of power commercially to great distances, thereby opening avenues to the manufacturer of electrical apparatus before impracticable, and enabling the development of otherwise unprofitable water power.

In Canada this field promises to be of prodigious proportions. This class of business usually calls for apparatus of large capacity, and the equipment of the new factory has been planned and carried out to meet this new demand. To the former extensive equipment was added larger tools, among them being two boring mills, one adapted to finish parts of apparatus having a diameter of seven feet, the other capable of finishing parts having a diameter of twenty feet (the latter tool, by the way, being built in the factory itself), a planer, probably the largest of its kind in Canada, also an electric crane capable of hoisting and moving to any part of the building masses of 30 tons in weight, together with several drilling machines, bolt and screw making machines, punches and other accessory tools. Thus equipped the factory is capable of, and is actually at work now in the manufacture of dynamos (namely, those for the Chambly water power), each of which will aggregate in weight upwards of 100 tons and each capable of developing 3000 horse power, being the largest dynamos, except those at Niagara Falls, that have ever been made. Besides these there are being manufactured at the present moment for the Montmorency Company, of Quebec, two dynamos, each of 1000 h. p. capacity, and two each of 350 h. p. capacity, and there have been just completed for a water power, 16 mile transmission plant from Narcisse to the city of Three Rivers, two each of 400 h. p. capacity, and the dynamos aggregating 2500 h. p. capacity, which you have just seen in operation in the station in which you are now, a total for the four places of upwards of 25,000 horse power.

The S. K. C. system is the only one in which dynamos are made to deliver current at very high voltages directly from the generators. Those now in operation at, as well as those being constructed for the Montmorency Company of Quebec, are being operated and will operate at a voltage of nearly 6,000 volts. The Chambly generators will deliver directly from the machines to the lines 12,000 volts. In all other systems the high voltage necessary to convey electric current long distances must be obtained by other devices, known as transformers or converters, the generators usually only delivering a pressure of 1000 volts and the transformers increasing such pressure to the voltage desired. The transformation involves a loss of energy and is a source of interruption and expense, besides its increased cost, which is unnecessary with the S. K. C. system.

The S. K. C. system is alone in this feature, and this characteristic opens the way for the Royal Electric Company to be the advanced leader in the electrical field for light and power purposes, and particularly where the transmission of power to considerable distances, and in large quantities is required. These conditions practically constitute the Royal Electric Company as the engineers for such systems.

Since the introduction in the early part of 1894 of the S. K. C. system in the United States, which was practically first introduced in the early part of 1894, to the present time, there has been put in use or are in process of construction under order in the United States and Canada, generators of this system of a total aggregate capacity of about 600,000 horse power.

Another appliance of the S. K. C. system, namely, the transformer, also revolutionized that necessary adjunct of every alternating current lighting plant, which, as made before the introduction of the Stanley transformer, was a source of the greatest expense to such stations.

Since the introduction by the Royal Electric Company of these transformers into Canada, their value in the prevention of waste has been frequently demonstrated and is now so firmly established that every electric lighting station, in the endeavor to improve its earning capacity, is displacing the old types of transformers, which have been in use and substituting therefor S. K. C. transformers.

Although first offered to the electrical public but a few years ago, there are in use to-day S. K. C. transformers having an aggregate capacity of upwards of 1,000,000 lights, and the demand for them is constantly increasing.

The peculiar success of the S. K. C. system is due to the new features and principles it embodies, but is also equally due to the extremely high character of the methods and materials employed in manufacture. These methods require the utmost accuracy, the greatest care, the best materials and the finest finish.

The manufacture by the Royal Electric Company of the S. K. C. apparatus is carried on in direct accordance with the plans, specifications, drawings and methods in use by the Stanley Electric Mfg. Co. in their own works, and in every detail and particular are exact duplicates of those made by them. All the advantages of contact with the widely extended field covered by the Stanley Company in the United States are available to and at the disposal of the Royal Electric Company, and are utilized for the benefit and are at the service of its customers.

The factory is planned, equipped and manned for the manufacture of high class apparatus only, and is devoted solely and entirely to work of that character. When the introduction of this class of electrical apparatus was begun by us we were told by some of our good friends that there was no market in Canada for this class of goods. Our experience during the last two years fully and completely refutes that suggestion, for we have found that when we made known in actual practice the fact that electrical apparatus of this character was available, the best and only the best was wanted, and the result is the condition of our factory to-day—engaged to its utmost capacity in the fulfillment of orders, being in many cases repetitions of previous orders.

The S. K. C. system, however, does not constitute the entire business of the factory, the manufacture of direct current dynamos and motors, arc lamps and machines, and railway generators and motors adding materially to the demands on the capacity of the works; a recently completed order being the entire new equipment of generators and motors for the Montreal Park and Island Railway Company.

The manufacture of insulated wire and of many kinds of instruments and other appliances is extensively carried on, and since the beginning of the business of the company it has installed in Canada 70 arc light plants, using an aggregate of upwards of 8,000 arc lamps, and 145 incandescent plants, with a total capacity of more than 250,000 lights, distributed from Victoria in the west to Prince Edward Island in the east.

Judging, therefore, by the past of the Royal Electric Company, and by its present conditions and demand for its manufactures, with the large new opportunities opened by its S. K. C. system, the future bids fair to tax the capacity of this complete factory to its utmost working power night and day. At the present day, the business already in hand will keep it constantly occupied at least during the present year, working day and night.

With such improved apparatus available, it became incumbent upon the Royal Electric Company to utilize in its own illuminating business the advantages obtainable from the S. K. C. system. To that end about a year ago the board of directors authorized the improvements which have been recently completed in its lighting system—these improvements being the placing of Stanley transformers upon its lines of the S. K. C. generators, which you have just seen, in this station, and the erection of the new distributing switchboard.

One of the advantages resulting from these improvements, which will appeal directly to our shareholders, is that with more than 10,000 lights connected to the station at the present time than there were a year ago, and although the improvements have practically been only just completed, an economy has been accomplished in the item of fuel to the extent of 6,000 tons; that is, there was consumed during the year 1896, with the increased business, 6,000 tons of coal less than during the year 1895.

When the improvements within the station were begun a year ago, the four engines, two of 500 h.p. capacity and two of 1,000 h.p. capacity each, were connected to some thirty separate dynamos by means of lines of shafting on two floors of the station. As you have just seen, three of these engines are connected directly by belting directly to what are practically three dynamos, the fourth engine being at present not required.

Any of you who saw this station a year ago will remember that the entire space of the first and second floors was completely filled with shafting, pulleys, belting and dynamos, and both floors presented an exceedingly crowded condition. As you have perceived to-day, the first floor alone fulfills all the purposes of the station, and its condition is open, roomy, bright, cleanly and cheerful.

The switchboard, which bears the same relation to our lighting and power systems as the pilot house does to a steamship, and controls the distribution of the electric current from the generators to the premises of our customers, has been especially designed and constructed with two important considerations in view; the first to secure an entirely incombustible condition, the second to obtain a flexibility and facility of operation which will enable the transfer of any circuit to or from any generator so quickly as to be practically imperceptible when all the lights are burning.

The first condition of incombustibility is a necessity to insure permanent service to our patrons, and has been completely accomplished. The second condition secures uniformity of service to our customers, a condition which we have abundant reason every day to realize has also been accomplished.

The switchboard is so arranged that any circuit, with every light thereon burning, may be instantaneously transferred from one generator to another without perceptible change in the light, and this is done so frequently without being noticed that it is the best possible evidence of the complete adaptability of the switchboard to its purpose.

A fact in connection with these improvements and the change from the old system to the new is, that all of these changes were made without the interruption for a single instant of the service to

the upwards of 60,000 lights served from this station, which is in operation continuously during every hour of every day in the year.

To those familiar with the handling of electric currents, this will seem a feat almost without parallel; and even to those who are not familiar a consideration of the labor, risk, care and rapidity of action involved in transferring nearly 100 wires, all of them charged with electrical current, from nearly 30 dynamos and the old switchboard to 3 dynamos and the new switchboard without the least interruption, will represent a work of great magnitude.

This entire change from the old system to the new, from the old to the new switchboard, was made within the period of ten hours, our customers obtaining their service undisturbed.

The dynamo and the switchboard are models in arrangement, with abundance of room, ready opportunity for attention, and complete capability of control and manipulation.

As the generators are of the two-phase system, we are able to furnish from the same machines and on the same wires incandescent lights, arc lights and motive power, and we are now prepared to furnish current for motive power purposes in any part of the city, and can furnish such power measured by meter, the same as incandescent light is used.

All of this work and all of this apparatus within the station has been placed not only for the purpose of improving our present system of electric lighting and increasing the opportunity for the use of electric currents for motive power, but it has also been done especially with a view to being utilized in connection with the electric current to be transmitted from the water power generator plant at Chambly.

The switchboard has been constructed so as to be capable of handling and distributing current for upwards of 200,000 incandescent lights and equivalent capacity in electro-motive power.

The generators at present operated by the steam engines are designed to be operated by the electric current from the Chambly water power as motors, wherewith will be operated the necessary complement of arc light dynamos to serve current for all the arc lights in the city streets and public places, as well as to operate the direct current generators now supplying current for motive power. The circuits for such direct current motive power will be maintained, so that customers having motors available for use on such current can be supplied with such power.

Within this station will be placed transformers to reduce the high voltage on the lines from Chambly to that used for distribution throughout the city. This current will be conveyed to the present switchboard and thence to the lines already extending throughout the city, and also to the generators, which will then become motors. The entire system of lighting and power now carried on in this station and at the east end station will be served entirely from here, as will also any additional current required for increased business, the entire distributing system being concentrated in this station, with practically no alterations in the present equipment.

The east end station will be maintained in its present condition as a steam generating arc lighting station, to be used as a relay or emergency station only. The steam engines in this west end station will also be retained in their present position, and in the extremely remote contingency of an interruption from any cause in the delivery of the current from Chambly, the motors will immediately again become generators and perform the functions they are now fulfilling. With this arrangement there will exist a water power plant and a steam plant entirely independent of each other, insuring absolute continuity of service.

The maintenance of the east end station in its present condition and the arrangement of this west end station, so as to be promptly transformed again into a steam generating station, is a precaution taken against what is assuredly a very remote contingency, but it has been so arranged in order to remove all opportunity for interruption of service to our customers.

That there is extremely little chance of interruption in the delivery of current from the Chambly water power into this city may be determined by a consideration of the conditions entering into its development, and at this juncture it is appropriate to speak of the Chambly water power generating and distribution of electric current therefrom.

The dam being built is to be one homogeneous mass of concrete, forming practically a monolith or a structure made of but one stone. This dam has been designed and is being built under contract by the foremost hydraulic engineering company on this continent according to the plans and under the direct supervision of its chief engineer, who is recognized as the most competent authority in this character of construction.

The wheels are also to be provided by and are under contract with the same engineering company.

The entire hydraulic work has been contracted with the above mentioned company under guaranteed results, among which are the maintenance, at all times, of a working head of 28 feet and the delivery to the shafts of the electrical generators of not less than 20,000 horse power. There will be eight units or sets of wheels, each of a capacity of 2,500 horse power. Each of these units or sets of wheels will be connected directly without the intervention of any gearing or appliance to cause loss of energy to the shaft of one electrical generator,—in fact, the shaft of each set of water wheels and of each generator will be practically one continuous shaft, thereby reducing to a minimum the loss of energy and the occasion for the expense of repair.

Besides these eight sets of wheels and generators, (the generators we have already described as being under construction in our factory, and each of which will weigh 100 tons) there will be two sets of water wheels, each operating an exciting generator of capacity sufficient to supply the excitation current required by all of the generators.

The dam, as stated before, will produce a head of water 28 feet

in height and will utilize the entire water of the Richelieu river, the outlet of Lake Champlain. The reservoir or head race thereby created will extend up the river from the dam to a point where the level of the water in the head race will merge with the natural level of the river, such point being a mile and a half or more above the dam, thereby securing a very long deep mill pond, which, with the high working head of 28 feet, will effectually remove all possibility of that bug-bear of water powers in cold climates,—frazil.

The location of the dam has been selected at a point where the highest known rise of the water in the Chambly basin below the dam will not affect the level of the tail race. Therefore all possibility of interruption due either to frazil or back water is completely removed.

The character of the construction of dam, power house, wheels, dynamos, switchboard, is all of the highest order. There are no gears to wear or break, there are no wire-wound armatures liable to destruction, there are no commutators, brushes or wearing parts in the dynamos, the only wearing parts in the water wheels and electrical machinery being the shaft and its bearings,—consequently every source of danger has been apprehended and guarded against.

The current will be conveyed from the power house at Chambly to the city of Montreal by two separate lines of poles and wires. Should an accident happen to any part of either line of poles or wires necessitating repairs, the current required will be transmitted by the other line during the time such repairs are being made. This will permit such repairs to be made without interruption to service or danger to employees, because there will be no current passing over the line being repaired as the other line will carry all that is required.

Arrangements have been consummated with the Grand Trunk railway, whereby the wires for the crossing of the St. Lawrence river will be carried on the Victoria bridge, and there also the wires will be so placed that a duplicate system corresponding to the duplicate pole line will be provided. The same duplicate system will be employed within the city from the bridge terminus to the distributing station. No danger of interruption from injuries to pole lines can therefore be apprehended.

All the work and material for the Chambly water power electrical transmission plant is under contract to be completed by September 1st, 1897. The progress already made in all the various parts of the work assures completion in accordance with the contracts, so that in September of this year, this west-end station, which is now a generating station of large size, will become merely a distributing or sub-station of the one at Chambly, the second largest electrical generating station in the world.

The advent of the electric current from Chambly will create new conditions in the city of Montreal.

The low price at which electric current can then be supplied will permit its use in many directions not now considered.

Its use for illumination will naturally become greatly increased, but the greatest advantages from it will accrue to commercial interests. Motive power will be available at rates which will not only render it profitable for present users of steam power to abandon it, but numerous new industries will be attracted to and established in the commercial metropolis of Canada where, in addition to the many other advantages it possesses, power will be as inexpensive to the manufacturers as if they were located directly upon some water fall with the usual disadvantages and expense of inaccessibility and inconvenience. It must have a direct, immediate, and permanent beneficial influence upon the value of real estate in the city and vicinity because of the largely increased demand for land required for additional manufactures. The appearance of the city, as well as its hygienic condition, and, therefore, also its value, will also be greatly improved, for, as it will be unprofitable to operate steam plants, they will be discontinued and soon will disappear with their necessary accompaniment of that black smoke which produces the dark, murky cloud that now so often hangs like a dismal pall over the city, shutting out its beauty, begriming its buildings, soiling the furnishings and decorations of its residences as well as the clothing and persons of the inhabitants, and impregnating the atmosphere with matter detrimental to health.

Besides accomplishing these material benefits in the commercial interests of the city, the electric current from Chambly will become the handmaid of domestic service, will lighten the labors of the household, affording the means of cooking and heating without the labor of handling coal and ashes, or the disagreeable adjuncts of scorching flame or of offensive odors; making easy and agreeable the service of the kitchen, laundry and the sewing room, and, most important of all, with these results will come vastly increased safety from fire; your insurance statistics will indicate most graphically the numerous sources of dangers in this respect which will be removed by the extended use of the electric current above outlined.

The diminished cost of electric current for illumination will very extensively increase the use of light; exteriors as well as interiors of buildings and windows will be illuminated for decorative effect; public or street lighting will not alone be extended into every street, by-way and lane, but will be increased in number in every street, which will be possible within reasonable expenditure, and the city will become bright, cheerful, healthful and clean, and its streets at night will be as safe as under the glare of the noon-day sun. This is no idle anticipation nor a fanciful picture, but a very probably near-by reality.

The successful progress of the Royal Electric Company is a component of the increased prosperity of the city of Montreal, and through the use of its manufactures, the Dominion will obtain similar advantages.

We can, therefore, anticipate with pleasure as the result of your visit here to-day a more intimate knowledge of the Royal Electric Company, and in consequence not only your good wishes but your valuable friendly aid and assistance in promoting its enterprises to broader dimensions and still greater successes.

After making a thorough inspection of the lighting station and factory, under the direction of the officers of the company, the health of the President was proposed by Ald. Stevenson, and replied to in suitable terms by Senator Thibeau. In proposing the health of the general manager, Mr. Browne, Alderman Sadler remarked that Montreal was the best lighted city in America. A toast to the heads of the departments, proposed by Lieut.-Col. Strathy, was responded to by Mr. P. G. Gossler, chief electrician. After congratulatory speeches by Messrs. Frank Badger, Jr., John Morrison and D. Parigean, M. L. A., the company sang the National Anthem and Auld Lang Syne, and separated.

MR. WILLIAM THOMPSON.

WE have the pleasure of presenting to our readers the accompanying portrait and sketch of Mr. Wm. Thompson, the author of the series of articles on "Chemistry in the Boiler Room," and other contribu-



MR. WILLIAM THOMPSON.

tions which have recently appeared in the pages of this Journal, and which, we doubt not, have been read with interest and profit.

Mr. Thompson was born and educated in the home of the iron trade, Middlesbro, Eng. In 1883 he came to Canada, and found employment in Toronto and Brampton until 1891. Since 1891 he has been employed by Armstrong & Cook, as superintendent and chief engineer, operating their waterworks and electric light plant at Montreal West, Que. Both the electric and waterworks systems were installed under his supervision.

To thoroughly equip himself and master all the details of his profession, Mr. Thompson has taken a special course in analytical chemistry under the tuition of the well-known chemist, Prof. J. T. Donald, of Bishop's University, Montreal.

It may be safely predicted that Mr. Thompson's ambition, coupled with ability and push will yet place him in the front rank of engineers.

WORTH TWICE THE PRICE.

MR. G. Coop, Regina, N. W. T., in remitting his subscription to the ELECTRICAL NEWS, writes: "Your paper is worth twice the money."

QUESTIONS AND ANSWERS.

IN reply to Jas. McPherson's enquiry in your last issue, I beg to say that an injector should work under conditions stated, provided, of course, his injector is in good order, and feed pipe of ample area so as to reduce friction to lowest margin. I understand him to say his Blake pump has to force water a distance of 80 feet horizontally, and then go vertically, and receives its supply of water under pressure of from 20 to 40 pounds pressure. Cause of knocking is most likely poor adjustment of suction valves, which are probably adjusted to work at atmospheric pressure. Run your cold water into a barrel for a while and pump from this, and see if knocking disappears. If it does, set the spring on your suction valves to work at cold water pressure, or pump from a tank using ball-cock to regulate supply of water; the latter course is recommended.

WM. THOMPSON.

A. M. S., Manitoba, writes: "Can you tell me anything about this acetylene gas of T. L. Willson's of Hamilton? A man is getting it up here, and if his accounts be true there will be no electric light in the world in a few years."

ANSWER.—Acetylene gas has been known for many years, but it is only within the past few years that a method of producing it by electricity has been discovered. The value of an invention of this kind may be estimated from the length of time it takes to become universally used. If acetylene was able to displace electricity as an illuminant, it would probably have made more progress during the several years since its discovery. The fact is that there are many drawbacks to its use. Some people go so far as to say that some of these are so nearly insuperable as to make it certain that acetylene will do no great amount of displacing for many years to come. There are usually two sides to every question, and while much may be said in favor of acetylene, it has been found that the care and attention required in its use, together with its liability to explosion, are likely to prevent it from becoming very popular. This is without taking into account its expense.

"Operator," Millbrook, Ont., writes: "I would like to know what is the nominal candle power of an alternating arc lamp, taking 10 amperes and 28 volts. The lamp is of the Kester make."

ANSWER.—There is no recognized standard of nominal candle power of arc lamps, but 9.6 amperes and 45 to 50 volts is usually considered 2000 candle power.

"R. B." writes: "The area of the base of a cone is 450 sq. inches, what must be its height that its volume may be 1 cubic foot?"

ANSWER.—

$\frac{1}{3}$ altitude \times area of base = volume of cone.

$\frac{1}{3}$ altitude \times 450 = 1 cubic foot = 1728 cubic inches.

\therefore altitude = $\frac{1728}{150} = 11.52$.

From this can be quite readily found the length of the slant side.

$$\text{length} = \sqrt{\left(\frac{\text{diameter of base}}{2}\right)^2 + \text{altitude}^2}$$

$$\text{and as the diameter} = \sqrt{\frac{540}{\pi}} = 23.9"$$

$$\therefore \text{length} = \sqrt{11.95^2 + 11.52^2} = 16.6"$$

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

HAMILTON NO. 2.

At the last meeting of the above association, Mr. Stobbs gave an illustration of the working of the planimeter, and Mr. Norris showed the difference between the working of a slide valve with and without lead.

LONDON NO. 5.

The regular meeting of London No. 5 was held on Thursday, the 18th inst. It was reported that during the past two months the membership had been doubled. Mr. St. John, boiler inspector, of Toronto, was present, and answered many questions pertaining to engineering asked by the members. He impressed upon the engineers that valuable life and property were entrusted to their care, and that their responsibilities were great. Constant care and skill were necessary, and at times great presence of mind would prevent the breaking down of an engine, and even the explosion of a boiler. Mr. St. John lectured at some length on the steam boiler, and a hearty vote of thanks was tendered him by the association for his kindness.

KINGSTON NO. 10.

The members of Kingston association held an open meeting on the 18th ultimo, which proved to be one of the most interesting and instructive yet held. The president, Mr. Fred. Simmonds, opened the meeting with a few brief remarks, and called upon Ald. Elliott, who read a carefully prepared paper on "The Main House Trap and its Application from a Sanitary Standpoint." Mr. Harry Breck followed with an illustrated paper on "The Manufacture of the Incandescent Lamp," and a contribution on "The Steam Indicator." was given by Mr. McEwen, which will appear in the April number of the NEWS. A paper on "Gas and its Manufacture," written by Col. Kerr, superintendent of the Kingston Gas Company, was read by John Orr, and Bro. S. Donnelly gave a short talk on "Valve Motion," after which a hearty vote of thanks was tendered to the authors.

Bro. Geo. Hazlett, past-president of the Winnipeg association, who is a former resident of Kingston, was present, and gave an outline of the order in the west. He spoke of boiler inspection certificates, and thought that Ontario was rather behind some of the other provinces in this respect. Open meetings of the association will be held every three months.

POINTS ON SHAFTING.

The author of a paper on "Shafting in Factories," presented before the American Society of Mechanical Engineers, summarizes his conclusions on the subject as follows:

It seems to the writer that in ordinary machinery establishments an observance of the following rules might effect a saving that would be noticeable in the annual balance.

1. Use pulleys of large diameter on counters and narrow fast-running belts.
2. Use nothing but the best oil and plenty of it, catching all drip, and either purifying it or using it for some other purpose.
3. Have all the shafting and counters oiled regu-

larly and do not depend too much on automatic oiling.

4. Inspect line shafts from time to time, and see that they are in line and can be turned easily.

Many line shaft boxes bind at the sides when screwed down, sometimes increasing the turning moment 100 per cent.

THE NATIONAL TUBE WORKS.

AMONG the largest producers of pipes and tubing in the United States is the National Tube Works Company, of McKeesport, Pa. Being located practically at the mines of the greatest bituminous coal deposit of the world, with an abundant supply of lime, coal and iron ore, they operate under most favorable circumstances. The works were first established in Boston in 1865, and in 1872 the company built a small mill at McKeesport. To-day the works extend for a mile along the bank of the river and from nine to ten thousand men are employed. The annual capacity of tubular goods is over 250,000 tons, and the company are said to be the largest manufacturers of charcoal iron boiler tubes in the world. Owing to the rapid growth of steel making, in the year 1892 a complete steel plant was built near their blast furnaces, which enabled the company to control every stage in the process of manufacture from the raw iron ore to the finished pipes and tubes. The pipe mills are large enough to take nearly the entire product of the steel works, by which they are enabled to make for their pipe mills the highest quality of mild steel, of a special grade.

The blast furnace consists of two modern stacks, 80 feet high and 20 feet internal diameter. The power is furnished by a 3,500 horse power battery of boilers, and the average output is 18,000 tons of Bessemer pig iron per month. The steel plant comprises two eight ton converters and a 35 inch blooming mill with the necessary appliances. One of the features of the plant is the immense horizontal compound condensing blowing engine, the largest one turned out up to the time of its installation.

The boiler plant is also noticeable. It consists of about 2,500 horse power of the water tube type; all boilers fitted with automatic stokers. Slack coal is the only fuel used. The output of both the blast furnaces and the steel plant is especially limited by the fact that such great care is taken throughout to be sure that the highest possible grade of steel is produced. Six complete puddle mills are also kept for running when occasion requires for making iron piping. The rolling mill department consists of 14 different mills adapted to the various sizes of skelp required.

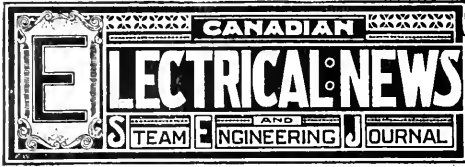
The tube works proper is most interesting. The pipe mill where the small gas and water pipe is made contains seven welding furnaces and other necessary machines. The lap-weld mills, where the boiler tubes and larger sizes of pipe are made, contain ten double bending furnaces and twelve welding furnaces. Pipe up to and including 24 inches is regularly made, and plans are under way for making pipe 30 inches in diameter. A new furnace recently completed is of a novel construction, and furnished with new electrical appliances. The pipe mill department also contain two large machine shops, a forge for making couplings for the pipe, a foundry, and numerous minor departments. The fuel used throughout the works is artificial gas, known as "producer gas," furnished by about 75 producers. After the pipe is welded, it is inspected throughout, tested to the stipulated number of pounds to the square inch of internal hydrostatic pressure varying from 300 to 5,000 pounds, and after a final inspection the goods are ready for the consumer.

As offering some faint idea of the varied and intricate details connected with this establishment, it needs but to be suggested that, from the one-eighth inch gas pipe to the huge 24 inch water, oil or gas main, there are above 1,000 several and different sizes of tubes turned out by this establishment, and on its blanks are carried regularly in stock.

In the process of manufacture an elaborate system of tests is employed from the beginning until the end, and every precaution is taken to ensure the most perfect result possible in modern skill and science.

The National Tube Works Company is capitalized at \$11,500,000, and has offices at Boston, New York, Pittsburg, Chicago, St. Louis and London, England.

The Valley Telephone Company held their annual meeting at Middleton, N. S., last month. Judge Savery was re-elected president, and extensions to the line were decided upon.



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The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 5 cents is added for cost of discount. Money sent in unregistered letters will be at sender's risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrears paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Central Stations vs. Isolated Plants.

Mr. R. S. Hale discusses, in the Engineering Magazine for February, the relative economy of electric current supplied by a large central station as compared with an isolated plant. He concludes that the economy is largely on the side of the large station, for the following reasons: The isolated plant is more expensive in first cost, excepting only the items of boilers and street conductors; if all the expenses are included, the cost of operation of an isolated plant is far greater than that of a central station. He therefore contends that it is cheaper for the real estate man, the hotel-keeper, or the drygoods merchant to devote his brains to making money in his own field, where he is an expert, than to waste his time on a small electric plant.

Improvements in Water Wheels.

The utilization of water power for the economical generation of electricity for light and power, besides creating a market for water wheels, is directing attention to the subject of water wheel design. The decrease in milling operations in Ontario in recent years, coupled with the total or partial failure of quite a number of water powers, led to the increased use of steam, with the result, we believe, that improvements in water wheel design and manufacture have scarcely kept pace with those in appliances for the generation of steam. As already stated, however, the increasing use of electricity is calculated to change this condition, and lead to the most careful attention being given to the design of water wheels, so as to secure the utmost generating power combined with the most economical use of water. At the recent exhibition at Geneva there was an interesting display of wheels, in which the Girard and Pelton types predominated. The horizontal type seemed to

have the preference, however, for low heads. A noticeable feature in all was the highly efficient regulators for use in the generation of electricity.

Improvements in Arc Lamps.

SPECIALLY noticeable during the last six months has been the wonderful improvement made in arc lamps for use on constant potential circuits—both direct and alternating current. That this is a very important matter will be evident to any station manager who is frequently asked for an arc light for a store, and whose street circuit is already full. In fact there are many cases where street lighting on the constant potential arc system would be actually preferable to the usual series system, and in the larger towns where a considerable part of the expense is the wages of lamp trimmers and carbons, the saving effected by using the long burning arcs, on the highly efficient D. C. machines would amount up to a very appreciable figure. There are many cases where an arc might be placed in front of a store window, or in the office of a hotel, and as it would have to be lighted at ordinary commercial hours, it would not be possible to put it on the street circuit. The difficulty, however, is solved, and business secured by this lamp, which is placed as an ordinary incandescent.

Canadian Electrical Association.

At a largely attended meeting of the Executive Committee of this Association held on the 25th inst., preliminary arrangements were made for the annual convention to be held at Niagara Falls, Ont. Wednesday, Thursday and Friday, the 2nd, 3rd and 4th of June, were selected as the dates for the convention. Committees were appointed to make the necessary arrangements and to secure papers. A number of valuable papers have already been promised, and the outlook for the meeting is a most promising one. Niagara Falls is at the present time the most interesting and instructive spot in the world for persons interested in the development of electricity. The enormous works of the Cataract Construction Co., the construction of which was in progress on the occasion of the previous visit of the Association to the Falls, are now in successful operation. Here are to be seen the largest generators in the world, and all the accompanying apparatus for the supply of electrical energy on an enormous scale. The line for the transmission of power to Buffalo, a distance of upwards of 20 miles, is also now in operation. These works will be open for the inspection of the members of the Association, and, combined with many other attractions, will tend to make the occasion a memorable one.

Fuel Economy.

WE would draw the attention of managers of steam operated electric stations, to the advantages to be derived from the use of fuel economizing apparatus—more especially so when, as is very frequently the case, the class of operative responsible for the generation of steam is by no means really competent to get as much good out of the fuel as possible. Owing to either poor design of boiler settings, or injudicious chimney and flue proportions, and largely to poor firing, the temperature at which the heated gases escape from the furnace into the chimney is greatly in excess of what would be necessary to produce a good draught, and any means whereby such excess of temperature can be made use of

is an evident saving. Probably the best way of utilizing this excess heat is to raise by it the temperature of the feed water, by causing the pipes conveying this feed water to pass through a special chamber in the chimney base and so come in contact with the escaping gases on their way from the boiler. Of course such an arrangement costs money, but the savings effected thereby are sufficiently appreciable to make it really worth while considering the question. To give a simple illustration of the gain in heating feed water, suppose a 1000-light plant, operating from dusk until daylight every night throughout the year, condensing, with coal at \$3.50. The water in the hot well will probably be at about 100° F., and has thus to be raised 112° before steam is generated. Such a plant will have an average throughout the year of about 300 horse power hours nightly, and 182,500 horse power hours for the year. The water required to be evaporated into steam will be somewhere about 75,000 gallons, and this has to be raised in temperature from 100 to 212°. To do this will be required not less than 50 tons of ordinary coal, which at our price is \$175. An efficient waste heat economizer would not cost \$1,000; the interest on the investment would be say \$60, and the other \$115 a clear gain. With a good economizer, as a matter of fact, the feed water can be raised to much above boiling point. We commend this to the careful consideration of our readers.

Central Station Management.

THE days of hap-hazard methods in the management of central stations for the supply of electric light and power are rapidly passing away. There are men to be found in this, as in other lines of business, who fail to heed the signs of the times, and who make little or no effort to keep abreast of the progress which is constantly taking place. The fate of such men is not difficult to predicate—sooner or later they will find themselves forced out of the business by their more progressive competitors. It is not going too far to say that every owner and manager of a central station who neglects to inform himself with regard to the latest improvements in machinery and operative methods is assisting to bring into use other forms of illumination, and is likewise placing arguments in the mouth of the advocates of municipal control. In view of the efforts which are being made to supplant the electric light, and to transfer the electric lighting business from private companies to the hands of municipal corporations, it behooves the owners and managers of central stations to bestir themselves to acquire exact knowledge of the latest improved apparatus and methods and the ability to apply this knowledge to the conduct of their business, so as to be able to furnish light and power in the most efficient manner, and at the lowest possible cost to producer and consumer.

A combine is announced to have been organized in the United States to regulate the prices of incandescent lamps.

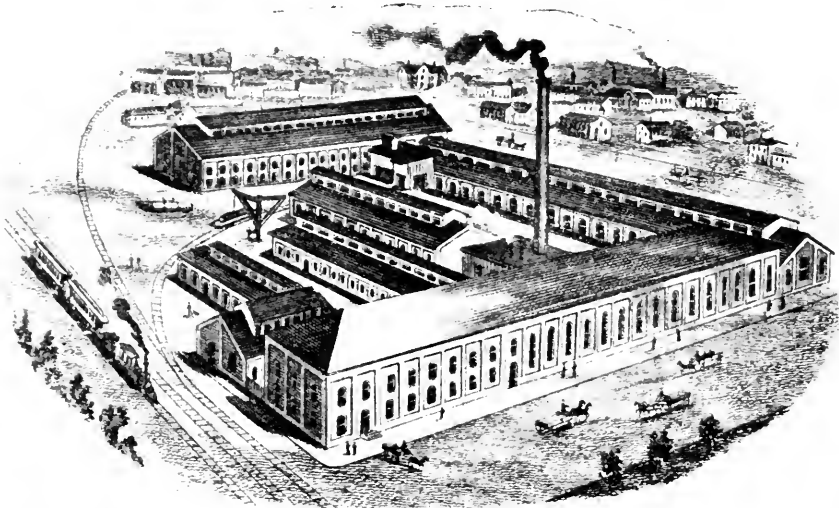
It is reported that the Kootenay Water Supply Company and the Kootenay Hydraulic Mining Co., of British Columbia, who have extensive water powers at Waneta and on the Pend d'Oreille, propose to amalgamate, with the object of utilizing in Rossland and other mining camps the 10,000 horse power they control. A large electric plant will be required, the distance being fifteen miles.

A NEW APPLICATION OF ELECTRICITY.

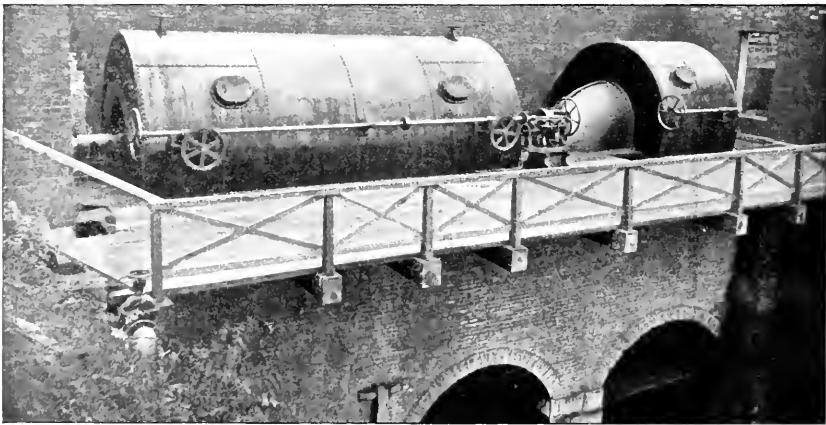
The introduction of electric power in the operation of the refrigerating plant of the Quebec Storage Company, in Quebec city, is another new field for central stations, with which to increase their day load. The plant being installed to drive the refrigerating machinery consists of two 50 and two 15 h.p. two-phase "S.K.C." induction motors; the larger of these motors are to be for the operation of the compressors and are now being set up, replacing two engines. These motors are belted

shafts arranged so that by friction clutch they can be made one. Each of these motors is arranged to operate on a fan for driving air over the pipes to be cooled, and also for operating a pump for the circulation of the brine. In this case also by the use of the friction clutch, either motor can operate one or both shafts and pumps. Each of these two 15 h.p. motors is also used to operate a freight hoist and can be used interchangeably.

The current for driving this plant will be supplied by the Montmorency Electric Power Company from their



WORKS OF THE S. MORGAN SMITH CO., YORK, PA.



The engraving represents a line of horizontal McCormick Turbines, consisting of one pair and one single 51 inch in iron cases. These turbines are developing 2,700 horse-power, which is taken off at one end of the shaft and is used in the cotton mill of the John P. King Manufacturing Company, Augusta, Ga. The McCormick wheel is the invention of John B. McCormick, who also invented the Hercules wheel. The McCormick is his latest invention and embodies points of merit in its construction which are not found in other turbine named. It is very heavy, strong, well built and nicely finished.

direct to two lines of shafting, which are so arranged that they can be made one continuous line by a friction clutch, the intention being that, if necessary, either motor can operate both compressors, or either one of them as circumstances may require, the compressors being driven by belting from the shafting described. From this same shafting will also be operated two pumps, which are used to bring about a circulation of the brine in the pipes.

The two 15 h.p. two-phase "S.K.C." induction motors will, in a like manner, be connected to two

two-phase "S.K.C." generating plant at Montmorency Falls, fully ten miles distant from the Quebec Storage Company's warehouse and refrigerating plant and thus, as above noted, superseding a steam plant, which has been in operation for the last few years, and it was found that the operation of the plant would be much more satisfactory and more economical by electric than by steam power.

The entire electrical plant is to be in operation by the first day of May next. The "S.K.C." two-phase motors, as well as the auxiliary apparatus necessary thereto, are being supplied by the Royal Electric Company, of Montreal.

CHEMISTRY IN THE BOILER ROOM.

By WM. THOMPSON, Montreal West.

PART III.

As already stated, carbon and oxygen enter into combination in two different proportions, and form two new chemical compounds, one of these being the result of perfect and the other the result of imperfect combustion.

The first of these is known as carbon dioxide or carbonic acid gas, and written symbolically C O_2 , meaning that two atoms of oxygen have combined with one atom of carbon to form the new chemical compound carbon dioxide, and as a result of this combination a given quantity of light and heat was given off at the exact time that combination between the two elements took place. It should be carefully noted that neither light nor heat is given out from the coal nor yet from atmospheric air themselves, until the two elements under consideration are brought into combination with each other under certain defined conditions, and that there is neither loss nor gain in weight as a result of heat having been given off. Nature provides that each element shall have a fixed atomic weight, and this has been fixed by chemists for carbon at 12 and for oxygen at 16; therefore, if carbon and oxygen have entered into chemical combination to form carbon dioxide the product will have a given weight; and if you take, for example, one pound of carbon and admit just sufficient oxygen to form carbon dioxide, you will require to admit $2\frac{2}{3}$ pounds of oxygen, and as a result will produce a certain quantity of light, a given quantity of heat, and exactly $3\frac{2}{3}$ pounds of carbon dioxide; although a direct and distinct change has taken place in these two elements; the carbon has disappeared as carbon in the solid state and oxygen has also disappeared as oxygen in the gaseous state, and a new gaseous compound has been formed having volume according to temperature and a weight corresponding exactly with the weight of the two elements combined before chemical combination took place. As a matter of fact both light and heat have been given off, still we have no loss in weight, proving conclusively that heat is not a substance stored away in the coal nor yet in the air, but is simply a result of the two elements, carbon and oxygen, having entered into chemical combination, and must be given off at the exact moment combination between the two elements takes place.

The new chemical compound C O has its own peculiar properties, and is neither combustible nor yet a supporter of combustion. It will not burn for the same reason that water will not; it has combined with all the oxygen it is capable of, and has practically the same effect on our fires, and must be got rid of just as soon as formed. Under equal conditions of temperature it is heavier than atmospheric air, a fact that will readily impress mechanical minds.

There is, however, another important chemical compound formed during the combustion of fuel, and already referred to as carbon monoxide, written symbolically C O . In this case only one atom of oxygen combines with one atom of carbon—the two elements combining in equal proportions to form C O —this as I have stated being the result of imperfect combustion. To an unlearned fireman there is apparently no difference between the two products C O and C O_2 —they are both compounds of carbon and oxygen, and in each case the carbon disappears and combines with oxygen to form a new gaseous compound, and during the act of combination in each case both heat and light are given off, but in vastly different proportions.

Roughly stated, C O may be said to have formed under following conditions: Let us suppose we have a covering of strongly heated carbon on our grate, which we cover with a layer of green coal. This fresh coal is at once heated, and since each atom of carbon has an equal affinity for oxygen the carbon acts as a reducing agent to the C O passing from heated carbon on grates, and reduces it to C O . If a supply of air is now given, the oxygen from the air will combine with C O and cause combustion to take place, the new compound passing off as C O_2 . It will be observed that C O differs from C O_2 inasmuch as C O is combustible while C O_2 is incombustible, and I may say another important difference is, that C O is very much lighter in specific gravity than air, and consequently easily escapes unconsumed to chimney.

Our great object as engineers is to get the greatest possible amount of heat out of the least possible quantity of coal. Every pound of coal we use, be it good, bad or indifferent, has a certain fixed calorific value as a heat-producing agent, past which we cannot go.

In boiler room practice and evaporation tests, all kinds of methods are adopted to arrive at the amount of what is termed "pure coal" burnt per lb. of water evaporated,—nearly all of

which are wide of any reliable results. Even in the highest practice it is a common thing to divide determination of elements in coal under four general headings, such as "moisture," "volatile substances," "carbon" and "ash." As a consequence of this very common error we often see the statement in print that the rate of evaporation per pound of pure carbon is so close to, or actually in excess of theoretical calorific value of this substance, that results are misleading and very often denied by well-informed engineers.

"Volatile substances" includes some very important elements for our purpose, and until we know what our "volatile substances" are composed of, and in what proportion, it is quite impossible for us to arrive at any reliable conclusion as to the calorific value of our fuel. As an instance, I might cite the highly important element hydrogen, which is contained in this class, and which has by far the highest calorific value of any of the constituent parts of our coal. The calorific value of hydrogen has been fixed at 62,000 heat units, or what is commonly termed British Thermal Units. A B. T. U. being, as, no doubt, your readers are aware, the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. Consequently one pound of hydrogen entering into combination with oxygen, as set forth in earlier articles on this subject, will form 9 lbs. of water and give off during the act of combination sufficient heat to raise the temperature of 62,000 pounds of water 1°F ., or, what is the same thing, evaporate 64 pounds of water from and at 212°F . under atmospheric pressure.

The calorific value of one pound of pure carbon has been fixed at 14,500 heat units, but this is subject to important chemical truths and conditions. This is the maximum calorific value of pure carbon, and to enable the engineer to secure this amount of heat he must have perfect combustion and completely for n the chemical compound C O_2 .

The importance of our closely following natural laws during combustion of our fuel and the actual need of at least a rudimentary knowledge of chemistry can not be better illustrated than here, let us briefly review our general statements. 1st. Hydrogen is separated when coal is decomposed by heat. 2nd. It is a very light substance, and under proper conditions as to temperature, combines readily with oxygen. 3rd. Carbon combines readily at a given temperature with oxygen in one of two proportions. 4th. Both the elements, hydrogen and carbon, have a distinct calorific value as a fuel.

That hydrogen on combination with oxygen during act of combination gives off 62,000 heat units or evaporates 64 pounds of water from and at 212°F ., under atmospheric pressure.

Carbon combined with oxygen in proportion to form C O_2 gives off during act of combination 14,500 heat units, or will evaporate 15 pounds of water from and at 212°F .

Carbon combined with oxygen in proportion to form C O gives off during act of combination 4,350 heat units, or will evaporate but 4.5 pounds of water from and at 212°F .

C O combined with oxygen to form C O_2 gives off 4,750 heat units or will evaporate but 4.9 pounds of water from and at 212°F .

Every engineer can readily see the importance of having as nearly perfect combustion as possible, of carefully preserving the element hydrogen from escaping unconsumed, and the important fact that combination must take place within the furnace since heat is only given off at the actual time and moment of combination between the elements. It is also just as important that the air current be properly regulated since an excess of oxygen will simply pass into the chimney unchanged, and with the nitrogen absorb a certain quantity of the heat given off, and consequently reduce the evaporative efficiency of the fuel.

Other than the understanding of the chemical reactions constantly taking place within the furnace, a knowledge of chemistry is invaluable to us, since it enables us by means of analysis to readily determine the component parts of our fuel and its value as a fuel. In the sample in question, leaving out the unimportant elements, we are enabled to arrive at its calorific value. Since it consists of 85% carbon, and as each pound of carbon has a value of 14,500 B. T. U., we get 12,325 B. T. U. from this source, and from the hydrogen 3,100 B. T. U., or a total of 15,425 heat units equal to the evaporation of 15.9 pounds of water from and at 212°F . under atmospheric pressure per pound of fuel used. Knowing the actual value of our fuel, it then becomes an easy and simple matter for us to test and ascertain our actual evaporation and compare with the theoretical value of our fuel and see exactly what we are doing, and thus determine the cause of any loss or lack of fair economy.

I noticed the statement recently that a nation's greatness

depends upon the chemical knowledge of its people, and I think every engineer, who has closely studied his profession, will bear me out in saying that the greater our scientific knowledge the more valuable we become as engineers.

In conclusion, let me illustrate what an immense field for improvement lies ahead of us as engineers in this very question of securing the greatest possible efficiency per pound of coal burnt. I have said that each pound of coal has a defined calorific value and that each unit of heat has a definite value and duty. Heat is energy, and energy cannot be destroyed, and, as a consequence, every unit of heat has a certain defined mechanical value. It has been fixed that the mechanical equivalent or duty of an heat unit is the raising of 772 pounds 1 foot high, or what is the same thing, the raising of 1 pound 772 feet high.

Let us take, for an example, a 100-horse power plant using 180 pounds of coal per hour. This quantity of coal is equivalent to $2,775,000 \times 772 = 2,142,763,200$ foot pounds, being the mechanical value of heat generated from this quantity of coal per hour. This is equivalent to 1,078 h. p., and still in our most modern plants we are only able to obtain 100 h. p., or about 1/10 the actual value of the fuel. This is our best practice, and I venture to say that the average plant does not utilize more than 3% of actual value of fuel. I confess this is rather a startling statement to make, but a fact nevertheless.

CORRESPONDENCE

THE DUTY ON ELECTRICAL MACHINERY.

HAMILTON, ONT., Feb. 11, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS

SIR,—In an article appearing in your February number entitled "The Duty on Electrical Machinery" written over the signature "Justice" several sweeping statements are made tending to decry the electrical industry in Canada.

Being directly interested in the design and manufacture of electrical apparatus, I would take exception to several of these statements as being wholly misleading.

The writer of the article starts out by saying that the electrical industry in Canada has no "raison d'être" and yet a little further down states that we have "several very excellent colleges giving electrical courses and degrees." Now I cannot see why the industry has no "right to be"; manufacture in this line to-day is based more on a matter of design and engineering and not on invention and research as in the early days of the art, and graduates of our colleges are supposed to be capable of designing a great part of the machinery as used in our lighting and power plants, and it is my candid belief that we have men in this country, many of whom working at nominal salaries in our various manufacturing factories, who are in every way qualified to do a great deal in this line if they but had the confidence and support of our manufacturers and would further proclaim their capabilities without "fear and trembling."

While I will admit that it would be useless, with our meagre experience and knowledge in this particular branch, to attempt to introduce heavy power transmission apparatus in competition with the highly developed apparatus of American design, yet there remains a great field for perfected constant potential and arc lighting devices, and for the classes of specialties which are always in demand, and because a few large alternators are imported there is no reason why the industry as a whole should be made to suffer in face of a tariff which would result in the flooding of the country with endless cheap apparatus.

There is of course no doubt that some of our Canadian made apparatus is not what it should be; as an instance we can cite the fact that there are not three firms in this country who make a modern and efficient constant potential motor or dynamo, but yet we have

not the slightest ground for an excuse for this state of affairs, as we have engineers capable of constructing modern apparatus if sufficient confidence were placed in their abilities instead of undervaluing same.

Being interested in the Thompson Electric Company I may state that the arc lighting apparatus of that firm is wholly of Canadian design in all its details, and designs are now being gotten out for open and enclosed arc lamps for either direct or alternating current circuits, which will enter the market in open competition with any imported or domestic article, both as regards efficiency and price.

The few articles entering into the construction of electrical machinery, which are of necessity now imported from the United States, would soon be furnished if the demand arose for sufficient quantities, and would it not be better to foster such industries, as well as retain the present ones, by guaranteeing sufficient protection, instead of doing the opposite by removing same?

Yours truly,

WM. A. TURBAYNE.

CLOSE REGULATION.

ST. MARYS, ONT., Feb. 22nd, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—Will you allow me space in your valuable paper for the following, which may interest some of the electrical fraternity? I am in charge of an arc plant, and have 28 lamps direct current. The power is supplied by an 80 h. p. Corliss engine, non-condensing; average steam pressure 70 lbs. I have also a small incandescent dynamo, 30 lights, and a flax mill, with variable load. During a test the other night I let the steam vary 25 pounds on steam gauge, with the result that the voltmeter only varied one volt during the whole change of pressure. This I think remarkably close regulation in speed. I would like to hear through your paper the experience of other electricians on same line, and how close is the average variation in such a case.

Yours,

JOS. H. WARD.

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 6.10	A. M. 5.40	11.30
2.....	" 6.10	" 5.40	11.30
3.....	" 6.20	" 5.40	11.20
4.....	" 6.40	" 5.40	11.00
5.....	" 7.10	" 5.35	10.25
6.....	" 8.20	" 5.35	9.15
7.....	" 9.20	" 5.35	8.15
8.....	" 10.30	" 5.35	7.05
9.....	" 11.40	" 5.35	5.55
10.....	.....	" 5.35	4.55
11.....	A. M. 12.40	.....	4.00
12.....	" 1.30	A. M. 5.30	3.10
13.....	" 2.20	" 5.30	2.30
14.....	" 3.00	" 4.30	2.30
15.....	No light.	No light.	.....
16.....	No light.	No light.	.....
17.....	No light.	No light.	.....
18.....	No light.	No light.	.....
19.....	P. M. 6.40	P. M. 9.20	2.40
20.....	" 6.40	" 9.20	2.40
21.....	" 6.40	" 10.50	4.10
22.....	" 6.40	" 12.00	5.20
23.....	" 6.50	A. M. 1.10	6.20
24.....	" 6.50	" 2.10	7.20
25.....	" 6.50	" 3.00	8.10
26.....	" 6.50	" 3.40	8.50
27.....	" 6.50	" 4.10	9.20
28.....	" 6.50	" 4.40	9.50
29.....	" 6.50	" 5.10	10.20
30.....	" 6.50	" 5.30	10.40
31.....	" 6.50	" 5.30	10.40

Total, 197.10

NEW ARC LIGHTING SYSTEM.

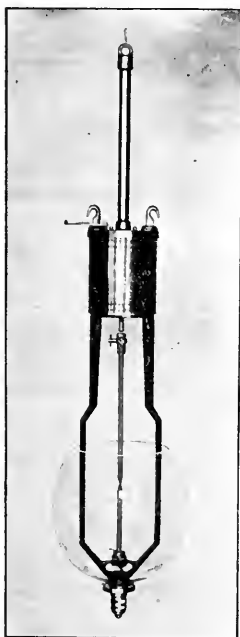
MANY of the arc lighting plants throughout Canada comprise in their electrical equipment dynamos which were designed some fifteen years ago, and which have not undergone since that period any radical changes of note, and arc lamps having birth about the same date, and which, although in some few cases they may have witnessed changes tending to cheapen the cost of manufacture, yet closely resemble the identical lamps of that period.

It is claimed that makers of arc apparatus have not made any pronounced digression from their original designs; they were too busy designing incandescent machines and perfecting the street railway, power, and the various alternating current systems of generating and translating devices, and as this work taxed to the utmost their staff of designers, and as the arc systems

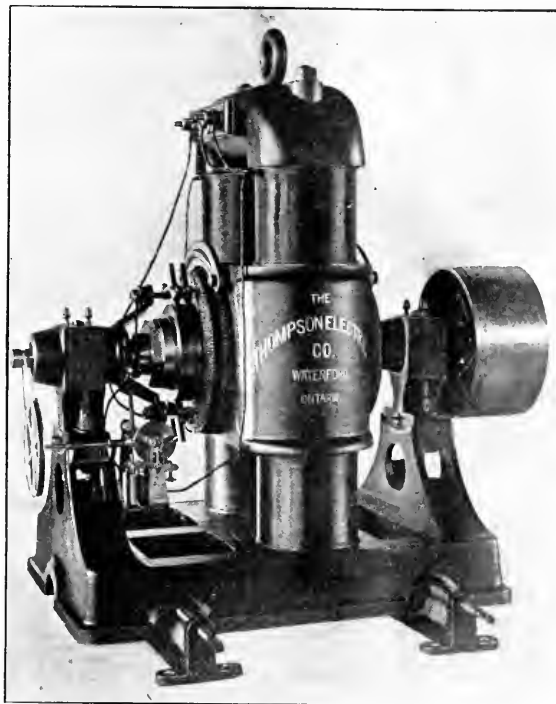
to the arc dynamos in use throughout the country to-day.

Arc lamps, and neat looking lamps at that, are now made by the same company, which are said to maintain a steady light through long periods of burning, and which are satisfied with a terminal voltage of 48 or 50 at the end of an all night run, and not 60 or 65 as heretofore. The gain is obvious; the dynamo is not compelled to furnish a constantly increasing E. M. F. in order to maintain arcs which lengthen as the shunt coils heat and carbons waste away, and the lamps burn at their most efficient wattage. This favorably affects the fuel pile.

The dynamo, the general outline of which may be noted by reference to the accompanying reproduction, possesses a number of valuable features. In the relative saturation of the field magnet and armature cores



ARC LAMP—THOMPSON ELECTRIC CO.



ARC DYNAMO—THOMPSON ELECTRIC CO.

of the day seemed to make light of some kind, and references to arc improvements were "pigeon-holed," and thereafter a long time remained.

Recently, however, a sort of arc lighting reaction has set in, and a demand has arisen for more efficient and serviceable apparatus, the older devices having been literally falling to pieces.

The Thompson Electric Company, formerly of Waterford, Ont., but now manufacturing in Hamilton, in order to meet this demand, prepared designs and constructed in detail a complete new system of arc lighting, including an automatic generator, lamps, and all station and outside accessories. They now offer a dynamo for which they claim some of the good features heretofore commonly associated only with constant potential machines, notably the suppression of sparking, a really genuine regulation, and a commercial efficiency largely over 50%, features which one cannot attribute generally

a wide departure from former practice has taken place, and the disposition and shaping of the pole-pieces have been so combined that as a result commutation is effected sparklessly throughout the entire range of the brushes, from full load to zero potential, and with but a single set of brushes having a constant width of lap. This calls for but one rocker-arm and greatly simplifies the regulating gearing.

The useful properties of a large armature reaction are employed in assisting regulation, and with the brushes in a fixed position several lamps may be switched on or off without greatly increasing or decreasing the current strength, although in practice the regulator immediately adjusts the brushes to a position of constant current value and of sparkless operation.

The manufacturers claim that the mechanical features of the machine, a substantial base, sliding rails for belt adjustment, self-centering pedestals with self-oiling and

aligning gun metal bearings, oil-gauges, and bored pole-pieces with a uniform width of air-gap, place it well beyond the criticisms of the operator.

The arc lamps, also illustrated, have been in use with eminently satisfactory results in a number of plants throughout the Dominion. They are substantially constructed mechanically and are correct electrically, and, in view of the greater number of lamps which are now placed on a single circuit, ample insulation is provided.

All parts of the mechanism perform their proper functions, both as regards feeding, cutting-out and re-lighting, on any current from 3 to 12 amperes, and the voltage across the arc remains practically constant throughout this range and during the entire period of burning, the feeding point remaining practically constant and the movements being imperceptible, resulting in a stable and unwavering arc.

In designing this lamp the greatest possible simplification, compatible with the most serviceable operation, has been the main object, and no complicated and frail devices are allowed to enter into its construction. The idea has been to abolish repairs and reduce operating expenses.

Current indicators, non inductive lightning arresters, and a complete line of improved station and outside accessories are embodied in this modern system of arc lighting. This system of apparatus is manufactured by the Thompson Electric Company, of Hamilton, under the designs of their electrical engineer, William A. Turbayne, and they will be glad at all times to furnish any information to any who may be interested in the matter.

THE AUBURN POWER COMPANY.

The following particulars regarding the plant of the Auburn Power Company, at Peterboro', Ont., which has just been put in operation, have been kindly furnished by Mr. W. H. Meldrum, managing director of the company.

The plant is of the three-phase type, for power purposes only, furnished by the Canadian General Electric Company, and is A. P. 36-250-200 type, having 36 poles, and operates at 200 revolutions per minute, having a periodicity of 60 cycles per second, with a potential at full load of 2,000 volts. The machine and exciter are driven by two 66 in. "Boss" wheels, made by The Wm. Hamilton Manufacturing Co., of Peterboro'. The shafting, crown wheels and pinions, with eye beams, breach trees etc., were furnished by Messrs. Wm. & J. G. Greey, of Toronto, and the operating of the same reflects credit upon the manufacturers, there being some 18 tons of iron outside of the water wheels. The gear runs as smooth as a clock. The whole driving arrangement is carried on four steel girders, 6 x 14 in., bolted to six solid concrete piers. The water wheels operate under a 15 ft. head of water on the Auburn dam, and are tabled to 450 h. p., and being coupled together, the same shaft extending to the generator, which is 12 ft. in diameter and rests on a solid concrete bed. A large coupling bolts the armature of this large generator to the shaft, making a thoroughly rigid direct-coupled plant. The power plant is all in shape, and the big generator weighs some eighteen tons. It is the intention to supply power to all classes of manufacturers in Peterboro'. The company have a large surplus of water.

SPEED BY ELECTRICITY.

Mr. W. J. Camp, of Montreal, writing in the Telegraph Age, says:

On page 467 of the last issue of the Telegraph Age appears an item from Electricity, London, suggesting the "use as a new unit of length for very great distances . . . over which an electrical impulse could be sent in one second; it is assumed that in one second a current impulse would travel seven times around the earth" (about 175,000 miles.) It may surprise many of your readers to be told that the speed of the electric impulse is very much less than is generally supposed. By actual experiment in Canada, between distant points, over No. 6 B.W.G. iron wire, without repeaters interposed, it was found that the speed was about 3-100 of a second per 1,000 miles, or 33,000 miles per second.

I might mention an experiment I tried last August. I made up a telegraph circuit from Montreal to Montreal (duplexed), with repeaters, as follows:—

	Miles.
Montreal	0
Sudbury	443
Fort William	998
Winnipeg	1,425
Swift Current	1,937
Donald	2,450
Vancouver	2,909
Portland	3,277
San Francisco	3,995
Albuquerque	5,195
Kansas City	6,011
Chicago	6,673
Toronto	7,315
Montreal	7,655

At McGill College, Montreal, a chronograph was connected and signals sent round the circuit, these signals being recorded when starting and also when completing the circuit. The average time occupied was .52 of a second for the 7,655 miles. I then connected the receiving side of one end to the sending side of the same end, so that a signal would be repeated back on the opposite side of the duplex, making a total circuit of 15,310 miles. The average time to complete the double circuit was 1.06 seconds.

Allowing 2-100 of a second for each of the twenty-six repeaters, this would make the speed only about 28,600 per second in the second case and about 29,400 in the first. The repeaters, of course, had to be estimated according to other tests, and the probability is that some of them occupied more time than others. Some of the repeaters were not well adjusted, as it was difficult to get the signals around the doubled circuit, a dash being reduced to a dot.

On a previous occasion the same circuit was arranged so that one end repeated into the other, and a signal started in one direction traversed the circuit eight times before it stopped. On another occasion a duplex circuit between Montreal and Vancouver, 2,909 miles, was connected at both ends, so that a signal went backward and forwards for over 200 times, and then only stopped on account of someone interrupting the circuit.

It is announced that acid in lubricating oil may be detected by putting the samples to be tested in a clear glass bottle, with a copper wire running down through the cork, air tight. Stand the bottle in a sunny place and let it remain for some days. If on removal verdigris or green rust is on the copper there is an acid in the oil. Such oil should not be used on machinery.

THE THREE-PHASE TRANSMISSION PLANT AT THE VALLEYFIELD MILLS.

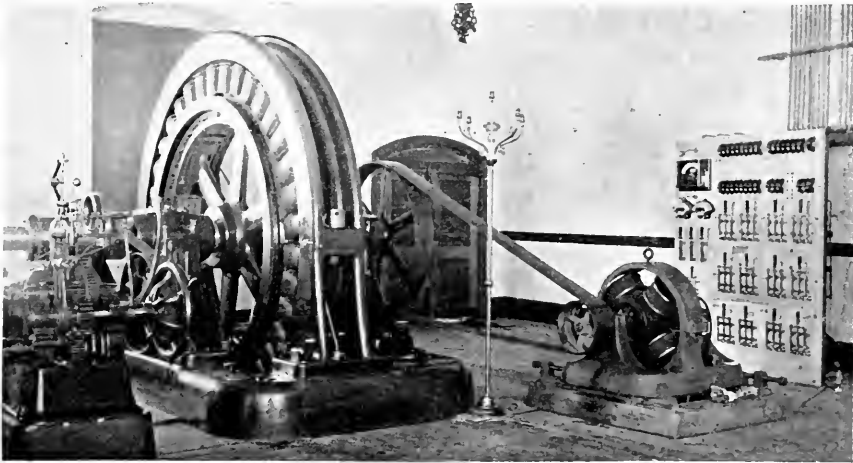
AMONG the most important of the great textile manufacturing establishments of the Dominion both in respect to the amount of capital invested and the value of the annual output are the mills of the Montreal Cotton Company at Valleyfield, P. Q.

At this point a dam erected by the Dominion Government to increase the depth of water in Lake St. Francis connects the Grande Isle de Beauharnois with the south shore of the St. Lawrence river creating incidentally an excellent water power. Upon this island, 23 years ago, the first mill of the company was built, containing 600 looms, the necessary carding and spinning equipment and a bleachery. About 16 years ago the mill was extended to contain 1,300 looms, and a dye house and finishing department were added to the bleachery. Three years ago the bleachery and dye-house departments were re-arranged and greatly enlarged and the mills have been enlarged each year since, until now they contain 80,000 spindles and 2,330 looms, and a bleach-

eight 60" McCormick turbines, each calculated to develop about 300 h. p., making a total of 2,400 h. p. The turbines are erected in pairs, each pair driving a 400 kilowatt generator. The lower part of the power house is all built in solid concrete, the power house proper above water, being built of stone, lined with terra cotta lumber. The roof is composed of 5 solid timber laid upon girders and covered with resin cement, and on the inside it is sheathed in steel, which is stamped out in panels and painted. Altogether the power house in solidity of construction and excellence of detail and finish is not excelled, if indeed it is equalled in America.

The wheels are governed by Replogle's new relay governors, the turbines being supplied by Mr. S. Morgan Smith, of York, Pa. The saddles and shafting were furnished by Wm. Kennedy & Sons, of Owen Sound, and by Mr. John McDougall, of Montreal. The gearing wheels were supplied by Mr. S. Morgan Smith.

For the electrical plant, as has been stated, the three-phase system of the Canadian General Electric Company



ELECTRIC TRANSMISSION PLANT AT VALLEYFIELD, QUE.

ery and dye-house large enough to handle 120 tons of cloth per week.

The large increase in the size of the plant during the past three or four years, combined with the lowness of water in the St. Lawrence, has rendered necessary an increase in the power plant of the company. This, up to last year, consisted of seven 60" and four 54" Hercules turbines and two 84" Risdon turbines.

The selection of electricity as the transmitting and distributing medium for the additional power plant was arrived at after a careful consideration of the first cost and losses involved in the various alternatives offered, of which the most feasible considering the comparatively short distance to which the power had to be carried, to the farthest point not more than 1,000 feet, was a rope transmission. The choice of electricity and of the three-phase system with induction motors was made after an investigation by the general manager of the company, Mr. Louis Simpson, of the principal plants operating under similar conditions in America, including the three-phase plants installed by the General Electric Company at the Pelzer and Columbia mills.

For the hydraulic portion of the new plant a new flume was excavated, which was arranged to contain

was adopted and a contract given to that company for two 400 kilowatt generators, the first of which has been installed and in satisfactory operation for about two months. The second machine will be in operation in the course of a few weeks. These generators, which are designated as A. P. 36-400-200 have 36 poles circumscribed within a steel yoke about the periphery of the revolving iron-clad armature and represent the latest development in design and construction for machines of this type. A point to be noted is the very slow armature speed, 200 revolutions per minute, which admits of direct coupling to the jack-shaft and of a consequent saving in power and floor space and a generally increased simplicity in the entire installation. The armature, which is of what is known as the A. P. type, is of the multi-tooth style of construction with distributed winding, and has, in consequence, a very low armature reaction with a correspondingly close inherent regulation. The generator voltage, on account of the short distance over which the power is to be transmitted, has been fixed at 350 volts, thus admitting of the current's being used directly on the motors at that pressure without the use of step-down transformers. The motors are of the C. G. E. Co.'s stand-

and induction type varying in size from 50 to 100 h.p. and are, where a saving in floor-space is desirable, of the inverted type, bolted to the ceiling. They are, of course, self-starting under full load, and as they are without collector rings or brushes, are especially suited for operation under the conditions favorable to combustion which exist in a cotton mill.

Altogether, the plant is a model one in every respect, and as the successful outcome of the first attempt on a large scale in Canada to secure increased economy by the use of electric power in the operation of a large industrial establishment reflects the highest credit on Mr. Louis Simpson, the able and energetic general manager of the Cotton Company, and his foreman mechanic, Mr. Jas. Sparrow.

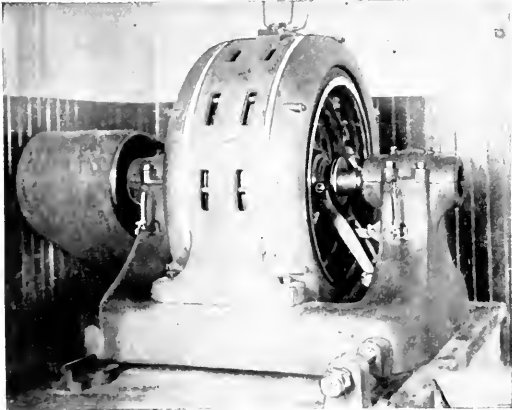
It might be added that the Montreal Cotton Company have now, as a result of the extension of their plant, a surplus of about 1,500 horse-power which they would be prepared to dispose of for manufacturing purposes, on a most liberal basis. The excellent situation and shipping facilities of Valleyfield should, under these circumstances, make it a particularly desirable manufacturing site.

PERSONAL.

Mr. F. L. Walmsby, an electrician in the employ of the Toronto Street Railway Company, died last month. He was born in Davisville 36 years ago.

Mr. W. H. Breithaupt has been elected president of the Berlin and Waterloo Street Railway Company, to succeed the late E. Carl Breithaupt. Mr. Harry Aldrich has been appointed electrician for the electric plant.

At the recent meeting of the Executive Committee of the Canadian Electrical Association the secretary was instructed to convey



ELECTRIC TRANSMISSION PLANT AT VALLEYFIELD, QUE.

an expression of the sympathy of the members of the Association to the relatives of the late Mr. E. Carl Breithaupt.

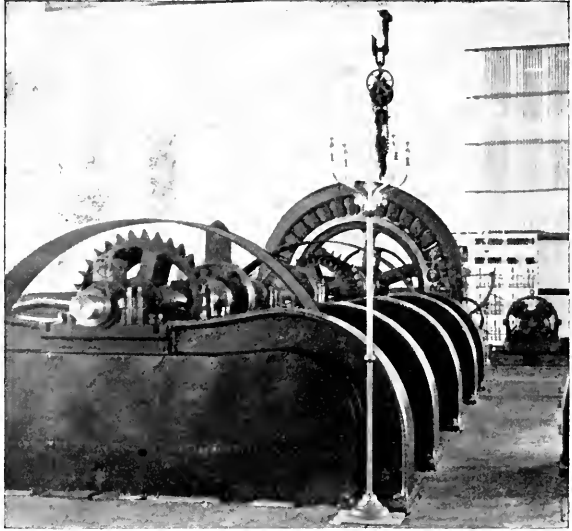
Mr. A. A. Knudson, electrical engineer, who is well known in the maritime provinces as the moving spirit of the electrical exhibition held some years ago in St. John, N. B., has recently entered into partnership with F. E. Knudson at 66 Broadway, New York. The firm will act as consulting and supervising electrical engineers.

The Welland Power and Supply Canal Company will apply to Parliament for authority to extend the time for commencing their proposed works.

TRADE NOTES.

The contract for the electrical equipment of the Montreal Park and Island Railway Company's suburban lines has been awarded to Ahearn & Soper, of Ottawa. Westinghouse No. 38 B. and No. 12 A. motors will be used throughout.

It is the intention of Mr. T. H. Breck, of Kingston, to commence business in that city on the 1st of April in the line of electrical supplies and novelties. Mr. Breck has been in the employ of the Kingston Light, Heat and Power Co. for four years, and during



ELECTRIC TRANSMISSION PLANT AT VALLEYFIELD, QUE.

the last two years has had charge of the arc lamp department of the company.

SPARKS.

Graham & Peckles, electricians, have commenced business at Halifax, N. S.

The annual statement of the Bear River, N. S., Electric Light Company showed the earnings for the year to be \$1,244.80, and the net expense \$661.30. Over seventy lights were added during the year.

The town of St. Mary's is extending its new electric light plant to 31 lamps. It is said to be giving thorough satisfaction at a cost of about 400 dollars less than the old system, and they now have 3 times the candle power.

The Hamilton Electric Light Company recently held their annual meeting, president Robert Thomson being in the chair. The statements presented by the secretary-treasurer were satisfactory, and the following directors and officers were re-elected. Robert Thomson, president; John Knox, vice-president; J. V. Teetzel, Q.C., secretary-treasurer; Robert Evans, Alex. Turner, J. J. Wright, S. F. McKinnon, H. M. Pellatt, Toronto. Gordon G. Henderson was reappointed manager, and C. S. Scott auditor. The president tendered a dinner to the directors and friends in the evening.

The annual meeting of the Toronto Electric Light Company was held on the 2nd of February. The report of the directors stated that the business done had shown a steady increase, and the earning capacity had been maintained, notwithstanding the decrease in revenue caused by a reduction in the price of light. The income for the past year for lighting, power, rent, etc., was \$265,897.46, while the expenses were \$172,234.69, leaving a balance of profit of \$93,762.77, out of which four quarterly dividends were paid at the rate of 7 per cent. per annum, amounting to \$75,119.94, leaving a balance of \$18,642.83 to carry forward. The old Board of Directors was elected as follows:—H. M. Pellatt, President; W. D. Matthews, Vice-President; A. H. Campbell, S. F. McKinnon, Hugh Blain, W. F. Murray, Hon. George A. Cox, Robert Jaffray, W. R. Brock, Samuel Trees, Thomas Walmsley, H. P. Dwight, Frederic Nicholls and Hugh Ryan.

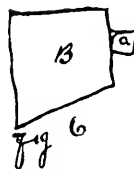
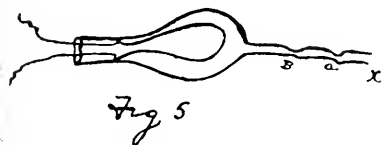
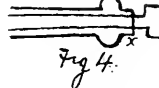
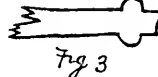
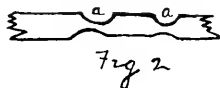
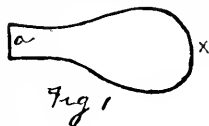
MANUFACTURE OF THE INCANDESCENT LAMP.*

BY HARRY BRECK.

THE incandescent lamp, as we see it, is made in two distinct parts. First I will describe the globe. The globe, as it is delivered from the glass works, comes in the form of a Florence flask, as shown in Fig. 1; this is heated and a cone drawn out at the part x (Fig. 1.) To this portion is placed a piece of glass tube shaped as in Fig. 2. The reason for the narrow portions (marked a a Fig. 2.) I will explain later.

The next operation is to make the base for the filament. A glass tube is taken and a portion of it near the end is thickened, as in Fig. 3. This afterwards fits into and is fused into the neck of the globe (marked a Fig. 1). Two platinum wires are then put in this tube and the end (marked x Fig. 4) is heated and the two wires are thus imbedded in the glass. Care is taken that these two platinum wires do not come in contact with one another. These wires are bent, as shown in Fig. 4, in the shape of an L. To these terminals are afterwards fused the ends of the filament.

After the filament (the manufacture of which I will speak of next) is fastened on by an electro deposit of copper to these platinum wires, the base (Fig. 4) is



fused into the neck of the bulb (Fig. 1 marked at a); it then appears as in Fig. 5. The end of the tube, marked x, is then connected to an air pump, and the vacuum procured. The end "a" is then fused, afterwards B, and the lamp is complete ready to be connected to the brass vase. The reason for the two sealings is to avoid all possibility of air escaping into the globe, a second sealing renders this impossible; and the reason that platinum wire is used is that it expands and contracts with heat almost the same as glass.

Now for the construction of the filament. This filament is NOT wire, as a great many suppose; it is practically the same substance we burn in our arc lamps, namely, carbon. This filament is made of carbonized bamboo. The carbon is taken and split several times, lengthwise, all the hard silicious outer covering removed, and the remaining straight fibrous portion is shaved down until it is of uniform thickness, and then cut to the required length. These are taken and pressed between two metal blocks which are accurately surfaced to each other. The projecting pieces of bamboo are cut away, except a small portion at each extremity. This leaves a fine strip of bamboo, with an enlarged portion at each end. These strips are then placed in moulds (the chief form being the horse-shoe shape of filament) of the shape required for the filament. These

moulds are of nickel, and in them are cut grooves of horse-shoe shape. A flat nickel plate is placed over them, and the whole is placed in an oven and heated to an immense heat, so the bamboo becomes completely carbonized. The filaments are then fastened to the platinum points in the manner already described.

You ask, "what about the gas in the fibres of the carbon filament; how do you get rid of it?" This is the method: When the lamp is being exhausted a current of electricity is sent through the lamp (this is set on when the lamp is very nearly exhausted) and any air or gas contained in the filament is expelled and passed out while the air is being exhausted. In a 16 c.p. lamp the current used would raise the lamp to a 32 c.p., and so you see only the fittest survive. It can be known when the gas is all driven out by the disappearance of the violet blue color surrounding the filament.

All that now remains to be done is to fasten the lamp to the base. The method of doing this is shown in Figs. 6 and 7. Two pieces of brass "a" and "b" (Fig. 6) are kept separated by a porcelain disc (see end view Fig. 7), the shaded portion showing the porcelain.

The shell b (Fig. 6) is made of thin sheet brass, and the part a (Fig. 6) is a brass rod about $1\frac{1}{2}$ " long and about $\frac{3}{8}$ " in diameter. These make the connections in

the socket. One wire of the lamp is soldered into this brass rod (a Fig. 6), the other into the brass shell (b Fig. 6). The lamp is fastened into this with plaster of Paris. This completes the process of manufacture of the incandescent lamp.

IN MEMORIAM.

SINCE the date of our last issue we have received from members of the Canadian Electrical Association and others many sympathetic references to the death of the late Mr. E. Carl Breithaupt. Among these are the following lines from Mr. D. H. Keeley, of Ottawa:

TO THE MEMORY OF E. CARL BREITHAUPT, VICE-PRESIDENT OF THE CANADIAN ELECTRICAL ASSOCIATION.

A light gone out! Alas, a light gone out!—
Whose full bright radiance, while it lasted,
Of times gave courage when lethargic doubt
Sat 'pon th' hoped emprise of one exhausted.

Brilliant the mind 'twas his to bring to bear
On all occasions affecting what we did;
He bore in all our aims a gen'rous share,
E'er helped investigate what's to us hid!

Miss him we will—alas, the light that's gone!
In all our growth of practice; in our convention halls;
Where'er obtains the need for brain and brawn—
Th' qualities outpushing our innumerable walls.

O he who shone so brightly in our sphere—
Who strove to make our onward way the fletcher—
Has left behind with us a memory dear,
Of pure devotion; of himself, a sweeter!

—A FELLOW MEMBER.

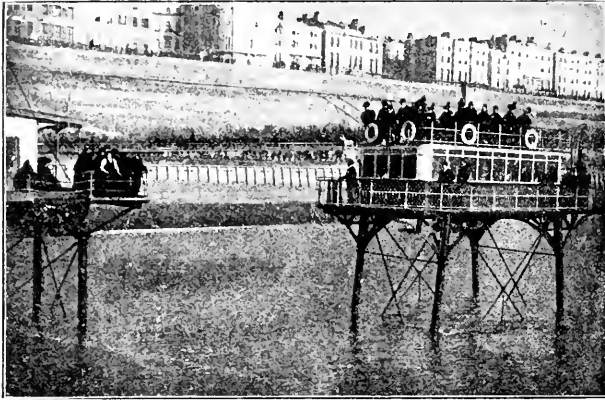
*Paper read before the Kingston Association of Stationary Engineers.

ELECTRIC RAILWAY DEPARTMENT.

A SEA-SHORE ELECTRIC RAILWAY.

An electric railway which has lately been put in successful operation between Brighton and Rottingdean, England, is one of the most novel systems which has yet come under our notice. The promoter operated a small sea shore tramway at Brighton, which he desired to extend to Rottingdean, a distance of four miles. The steep cliffs along the route made it necessary to

feet, which will give an idea of the width of the car. Much difficulty was encountered in laying the track, as work could only be carried on when the tide was low. The rails are fastened to concrete blocks, placed every few yards by means of steel clips and bolts, the latter passing through oak blocks placed between the rails and the concrete. Tie rods are used every ten feet on the straight and every five feet on the curves, heavy angle fish plates being used for the rail joints. The accompanying illustrations will enable our readers to a better understanding of the system.



CAR LEAVING PIER.

follow the foreshore, which was covered almost constantly with water, and at a point slightly above low water mark, but some fourteen feet below the sea at high water, the track was constructed.

It was proposed to run the cars at all times irrespective of the tide, which necessitated the building of a car of special design. It was made of a half boat and half car, mounted on four long legs, at the end of which are the wheels which run on the track. The car has 16 wheels, each leg of the car being mounted on a four-wheel bogie, and the wheels of the bogie run on the narrow gauge line. The bogie trucks are shaped like a double-ended boat to facilitate passage through the water as well as to remove obstructions from the lines. The four bogies are held together by steel tubular struts, and the wheel base is about 28 feet. The top of the main legs carry lattice girder work, on which the main deck is erected, the whole structure being braced together by means of cross ties. The main deck is 50 feet in length and 22 feet in width, surrounded by iron railings, provided with wire netting. There is also a saloon in the centre, with a second deck on top, and altogether the car will carry two hundred passengers.

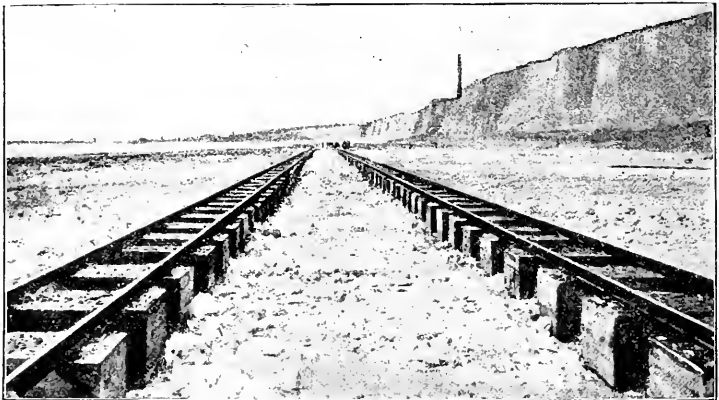
The track consists of four rails, 54 pounds to the yard, the distance between the two outer rails being 18

feet, which will give an idea of the width of the car. Much difficulty was encountered in laying the track, as work could only be carried on when the tide was low. The rails are fastened to concrete blocks, placed every few yards by means of steel clips and bolts, the latter passing through oak blocks placed between the rails and the concrete. Tie rods are used every ten feet on the straight and every five feet on the curves, heavy angle fish plates being used for the rail joints. The accompanying illustrations will enable our readers to a better understanding of the system.

The cars are propelled by means of overhead trolley wires of a special type, and on the cars are two 30 h.p. motors of the C. G. E. 800 type, placed vertically over two of the main legs, the armature being connected through bevel gearing to a vertical shaft geared to the axles of the wheels. The controlling devices are located at each end of the deck, and the brakes are operated by rods passing down the two unoccupied legs. The generating plant consisting of a four-pole railway generator direct-connected to a high-speed double-acting engine, is located at the Rottingdean end of the line. The machinery, however, is not of a sufficiently novel design to warrant a description. The total cost of the road is estimated at \$150,000, this sum including the construction offices at each end.

MR. H. J. SOMERSET.

Mr. H. J. Somerset has been appointed to the posi-



VIEW OF TRACK AT LOW WATER.

tion of Superintendent of the Winnipeg Electric Street Railway, to fill the vacancy caused by the retirement of Mr. G. H. Campbell, as manager.

For the last three years Mr. Somerset has held the position of electrician for the company, so that his appointment comes by way of promotion.

He received his professional training at the Worcester (Mass.) Polytechnic Institute, from which he gradu-

CANADIAN
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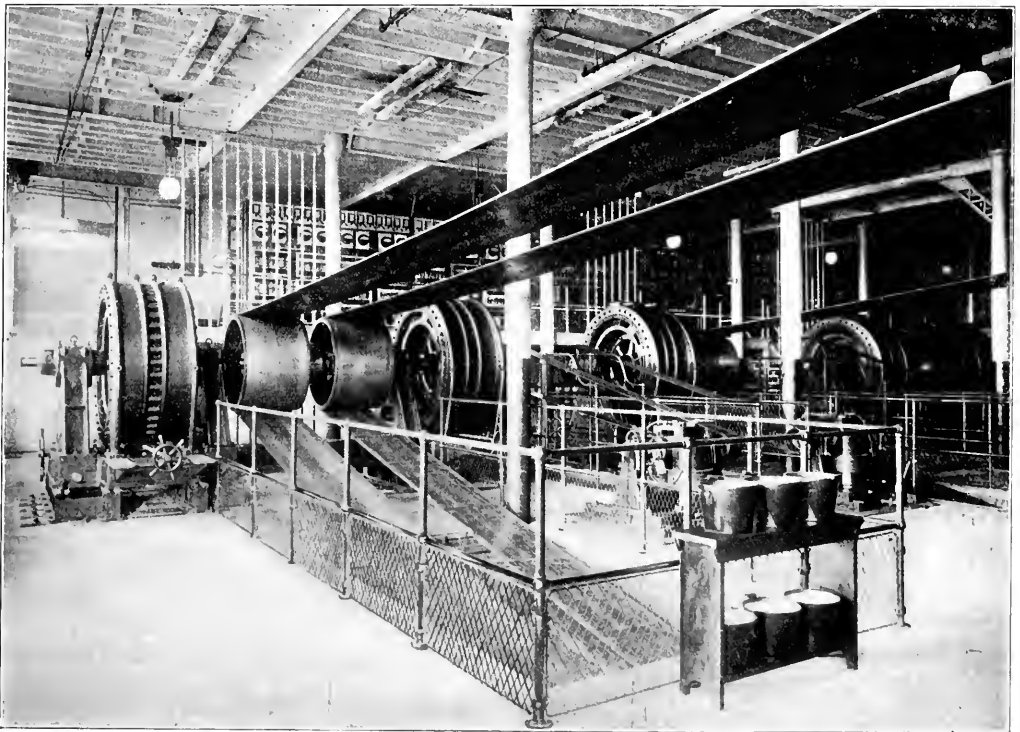
**RECONSTRUCTION OF THE ALTERNATING
CURRENT SYSTEM OF THE ROYAL ELECTRIC
COMPANY, MONTREAL, CANADA.**

By P. G. GOSSLER.

To meet the generally increasing demand for light and power supplied from central stations, it has, in many instances, been necessary to erect new generating stations, or to reconstruct the existing plant, discarding the old inefficient apparatus and substituting therefor equipment of modern design. In some of the larger

conditions. Besides, there is generally a multiplicity and variety of apparatus, the operation of which is accompanied with danger and unsatisfactory service.

The necessity of giving satisfactory and uniform service, of reducing the cost of operation, and of meeting the increasing demands for light and power being recognized, and the conditions being such as to permit of meeting these requirements, an investigation of the existing conditions generally results in the adopting of one of two plans: First, the building of a new generat-



S. K. C. GENERATORS, ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

cities this fact has apparently been appreciated for some time, as there have been erected stations which are magnificent examples of modern generating plants, operating with the highest economy obtainable at the present time and giving evidence in their design of the highest engineering skill.

Many generating stations at present supplying a large output have attained their growth gradually, having from time to time installed additional apparatus as it was required by an increasing business and extension of territory supplied. These stations are now confronted by figures and results showing their cost of operation per unit of output to be much more than it should be, or would if the same output was produced by more efficient apparatus operating under modern

ing station and equipping it with modern apparatus, utilizing the old plant for continuing the service during the course of the construction of the new one, and possibly retaining it afterwards as spare capacity, or secondly, to reconstruct or re-equip the existing plant to conform to the aforementioned requirements.

The latter plan of reconstruction will, without doubt, be decided upon in the majority of cases, as the use of large units permits of the installation of sufficient capacity, in the same space occupied by the old apparatus, to meet future demands for a reasonable length of time.

There have been numerous descriptions published giving examples of plants erected to replace those found to be inefficient and giving unsatisfactory service. It is to be noted that, so far, these new plants, with but few

exceptions, are direct current stations serving light and power to congested districts and comparatively small areas. This account is of the reconstruction of an alternating current system supplying current to a large territory.

The history of the Royal Electric Company of Montreal, and the growth of its lighting and power plants

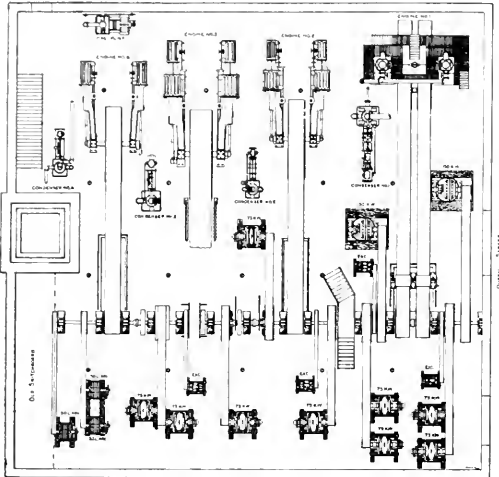


DIAGRAM NO. 1

from a 12 light arc machine in 1884 to the present time of serving about 65,000 incandescent lamps, 1750 arc lamps and 750 h. p. in motors has been told in previous issues of electrical journals.

Early in 1896 the directors of the company, upon the recommendation of the general manager, Mr. W. H. Browne, authorized the entire reconstruction of its alternating current station and lines—this reconstruction to be carried out upon plans which should adapt the system to be served either with power from its existing steam plant or from the water power plant at Chambly, which is at present being rapidly developed.

The foresight shown in the recommendation and authorization of this wholesale reconstruction and re-equipment has been well established by results already

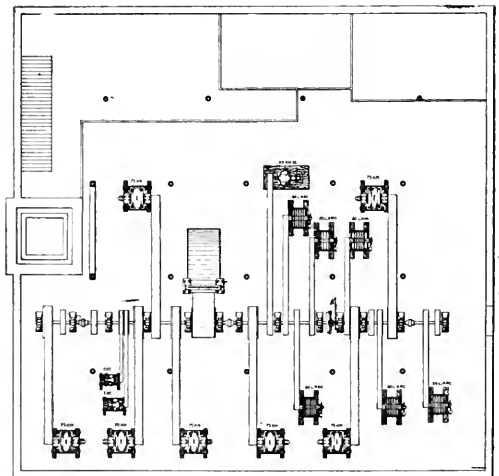


DIAGRAM NO. 2

obtained. The economy of replacing inefficient apparatus by apparatus which is the production of the highest grade of engineering is, in this instance, no longer a possibility but an established fact.

One of the generating stations of the R. E. Co. is devoted exclusively to supplying direct current arc service.

The equipment of the second or Queen street station, for serving light from an alternating system, with a spare series arc capacity, prior to its reconstruction, consisted of 18 alternators, 6 exciters and 9 arc machines, with their numerous belts, pulleys and shafting, shown in diagrams 1 and 2, representing the apparatus on the ground and first flats. The D. C. power generators and engines are located in a separate building.

The upright engine, known as No. 1, shown next to Queen street in diagram 1, was connected by two 30" belts to a line shaft from which were operated four 75 k. w. and two 150 k. w. alternators and 2 exciters. Operated from the line shafting connected to No. 2 engine were three 75 k. w. alternators and an exciter.

No. 3 engine, located on the ground flat was belted by a 50" belt to a line shaft on the first flat, shown in diagram 2. To this line shafting were connected seven 75 k. w. alternators, two exciters, one 45 k. w., D. C. generators, five 40 light and one 35 light arc machines. These latter were used only as spare capacity for the series arc system located in the east end station, and the 45 k. w. generator as spare capacity for the D. C. power system. The total capacity of the machines connected to this line shafting was much more than the capacity of the engine, consequently only part of the machines connected to No. 3 line shafting could be fully loaded at any one time. With that part of the shafting thrown out of service by the clutch shown at "A"

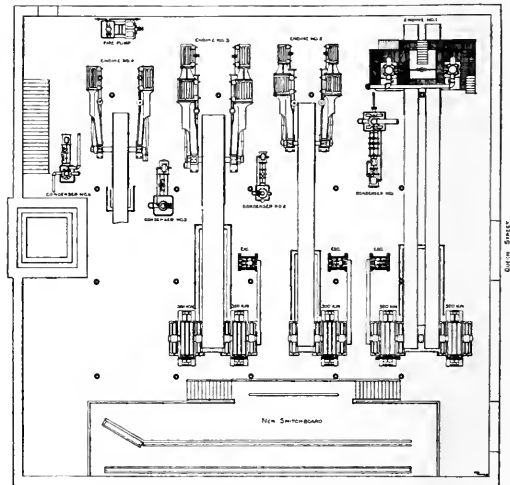


DIAGRAM NO. 3

diagram 2, there yet remained connected to the shafting in service three 40 light arc machines, which had to be up to speed whether they were required or not. To No. 4 engine were connected by line shafting two 75 k. w. alternators and three 50 light arc machines.

It will be unnecessary to give in detail the heavy line shafting losses, the dangers and disadvantages of such an arrangement of machines as shown in diagrams 1 and 2, as they will be apparent at first sight.

There was another danger which menaced the safety of the entire system—a wooden switchboard, the capacity and arrangement of which was entirely inadequate for the service required of it.

The alternators connected to the same engine were run in parallel, six operating in parallel from No. 1 engine, three from No. 2, seven from No. 3 and two from No. 4 engine. The ordinary advantages to be gained from operating in parallel were to a great extent offset by the fact of there being no clutches on individual machines. This also introduced irregularities and interruption to the service from armature burn-outs. In running so many comparatively small units in parallel it was difficult to overcome the "idle" currents in the alternators, and the numerous belts and pulleys required a nicety of adjustment which was hard to maintain after synchronism had once been established.

The foregoing statements setting forth past conditions have been made to illustrate the results of a gradual growth. It is needless to state that had the present demands for light and power been foreseen, and the efficient apparatus of to-day been available, the station equipment, in all probability, would have been far different from that which necessitated its entire reconstruction. The first step of this reconstruction was the rearrangement of the overhead lines. These had been divided into three routes, each taking approximately one third of the station output. The relative positions of the wires on the poles forming these routes were such as to cause serious fluctuations in the lights, due to mutual induction. This became so objectionable that it was necessary to operate all the circuits forming one pole line from one set of alternators running in parallel to get comparatively steady service. When the total load was too heavy to be run from one set of alternators, this condition of the pole lines neces-

represents the generating plant as it at present exists, occupying one instead of two flats—eighteen old generators being replaced by five 300 k. w. generators of the S. K. C. inductor type, the latter being belted directly to the engines. Also, in diagram 3 is shown the outline of the new switchboard, located overlooking the generator and engine room.

The five 300 k. w. S. K. C. 2 phase generators were built in the manufacturing department of the Royal Electric Company. To utilize the engines in their existing condition it was necessary to have the shafts of the two alternators for No. 1 engine rigidly connected, also the shafts of the alternators for No. 3 engine rigidly connected. The machines on No. 1 engine are run in parallel, also the two in No. 3 engine are run in parallel. This arrangement practically makes 600 k. w. units on both of these engines, at the same time having the many advantages of being able to subdivide these units and have four independent alternators.



MAIN DISTRIBUTING SWITCH-BOARD, ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

sitated the running of two or three engines underloaded, introducing a serious loss in coal consumption. The relative positions of the wires on the poles were changed to overcome this mutual induction and most satisfactory results were obtained, as after this change it was possible to operate any circuit from any engine without the slightest fluctuation resulting.

The transformer system was next rearranged, the old transformers being replaced by ones of close regulation and small core losses and secondary systems established wherever economical. The extent to which the latter was carried may be judged from the fact that 1161 old transformers were replaced by 628 "Stanley" transformers, with a consequent reduction in leakage load of 245 amperes, representing a tremendous saving in coal.

After getting the lines in shape attention was next directed to constructing a new switchboard and installing new alternators.

Diagrams 1 and 2 show the generating plant prior to its reconstruction, occupying two flats. Diagram 3

Due to the crowded condition of the station prior to reconstruction, the installing of the new machines and construction of the new switchboard, at the same time maintaining continuous service, introduced many conditions and difficulties not encountered in the erection of a new station. All of the available space being occupied by old equipment it was not possible to first install new apparatus to replace that which was to be removed. It was therefore necessary before beginning the station reconstruction to await such time as the capacity of one of the engines could be dispensed with, with the least danger of running short of capacity in case of accident to one of the other engines.

To have at all times sufficient capacity to meet the requirements and at the same time to have spare capacity for emergencies was of course the difficult part of the reconstruction.

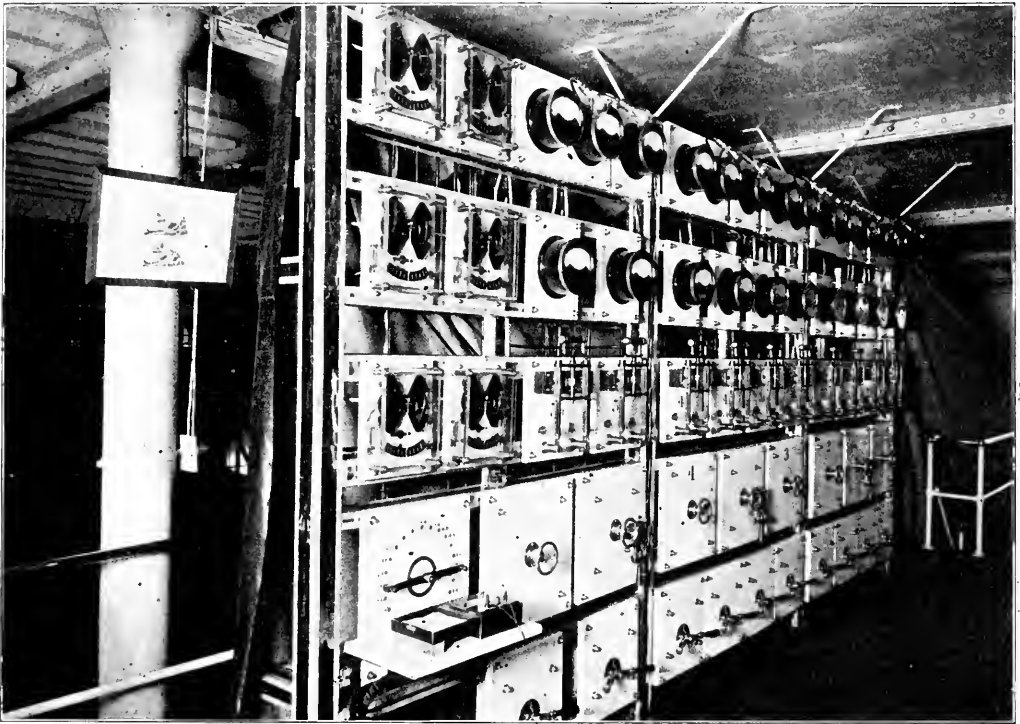
Work was commenced in the station by the removal of the old equipment connected to No. 2 engine and replacing it by one 300 k. w. S. K. C. generator. The apparatus connected to No. 3 engine was next replaced

by two 300 k. w. S. K. C. generators. No. 4 engine was then reconnected to part of the line shafting on the upper flat which had previously been run by No. 3 engine. By this time the full load was near at hand with the new machines yet to be installed on No. 1 engine. This was an unpleasant fact confronting us at this time, and it was a great temptation to allow the old equipment to remain on No. 1 engine until spring, but the saving sure to follow the installation of new generators on this engine made it advisable to complete the reconstruction. The load had increased to such an extent that it was not safe to be without at least, part of the capacity of No. 1 engine at all times. To provide for this there was installed, to be run temporarily from No. 1 engine, one 300 k. w. generator, and later, owing to a heavy increase in load, one 180 k. w. generator, both belted directly to the engine and running with very short centres to allow of the new generators intended to be run regularly from this same engine be-

larly difficult operation with the service "dead", the transferring without any interruption to the service was a rather ticklish undertaking. It was made in the day time, within a period of ten hours, without any interruption to the service or inconvenience to the customers, in fact, they were not aware at any time of the changes taking place in the station.

Cut 2 represents the generator board and cut 3 represents the circuit board and the terminal board of the new switchboard. The board has been designed on the "universal combination" plan, by means of which there is a universal interchangeability of circuits, dynamo and exciter connections, enabling any circuit to be operated from any generator, and any generator to be excited from any exciter.

Diagram 4 shows the arrangement of switches, rheostats and instruments on the generator board. The instruments on the top row, excepting the three mounted on single bases, are voltmeters, there being



GENERATOR SWITCH-BOARD, ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

ing placed in their proper positions, in line with the generators connected to No. 2 and No. 3 engines.

During the time of installing the new generators there was also being constructed the new switchboard. From the diagrams it will be seen that the location of the new board brought it directly over several of the old generators, and the close quarters in which the work was done in the station will be appreciated from the statement that the iron framework supporting the floor of the board cleared the eye bolts on top of these old machines, still operating, by only six inches.

The installation of the five 300 k. w. generators was completed by the middle of October just at the beginning of the heavy winter load, and the new 2 phase board was completed about the same time.

The transferring of the service from the old to the new switchboard transformed the entire alternating system from a single to a two-phase system. The operation of transferring the circuits from the old to the new board was, of course, made with all circuits alive, and while this transfer would not have been a particu-

larly difficult operation with the service "dead", the transferring without any interruption to the service was a rather ticklish undertaking. It was made in the day time, within a period of ten hours, without any interruption to the service or inconvenience to the customers, in fact, they were not aware at any time of the changes taking place in the station.

The circuit board consists of two rows of 4-pole switches, two switches being required for each circuit. These switches are so connected that by a single throw of one switch a circuit can be connected to any generator. Above the rows of switches are mounted ammeters, one ammeter for each phase of each circuit, and above the ammeters are fuse blocks.

In the rear of the circuit board is the terminal board, on which are mounted a single row of 4-pole switches, one switch for each circuit, and an auxiliary set of buss bars, and below these a row of recording meters. By means of these auxiliary switches and buss bars any circuit panel or panels on the main circuit board can be cut "dead" and the circuit or circuits transferred to the terminal board. As the buss bars on the latter can be connected to any alternator, the terminal board dupli-

cates to a great extent the circuit board and generator board. During the day the entire output can be handled from the terminal board.

Diagram 5 gives a floor plan of the switchboard and detail of iron framework supporting the slate floor. The location of the switchboard, shown in diagram 3,

over this two layers of mica, the edges of this framework being protected for mechanical purposes with fibre angles. This character of framework for switchboards was first used in the construction of the switchboard of the United Electric Light and Power Company, New York City, and after that company had made extensive

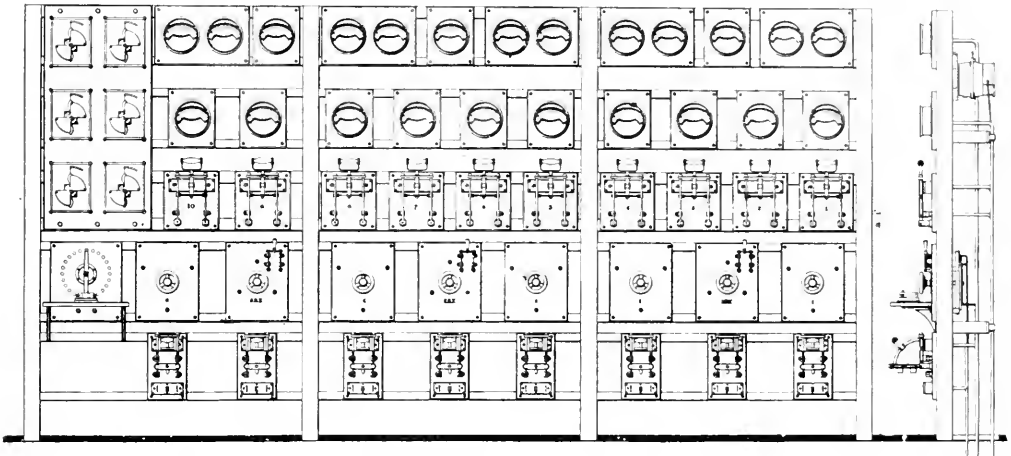


DIAGRAM NO. 4.

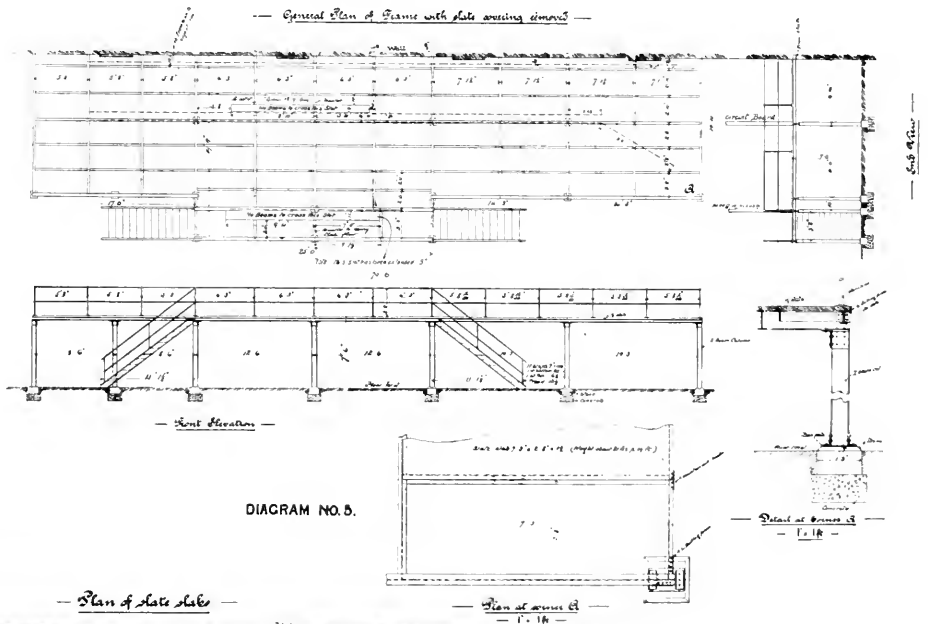


DIAGRAM NO. 5.



PLANS AND DIAGRAMS OF NEW SWITCHBOARD IN ROYAL ELECTRIC COMPANY'S ALTERNATING CURRENT LIGHTING STATION, MONTREAL.

directly in front of the driving belts of the engines, is of course not desirable, but it was the only available space. There have been erected heavy wrought iron bars immediately in front of the belts for protecting the board in the event of a driving belt breaking.

The framework of the switchboard consists of seasoned white oak, over which is a layer of asbestos, and

experiments with iron and frame switchboard construction. It is practically fireproof as well as being a good insulator, and from the severe tests during the past four years which it has withstood, there are reasons to believe that it is a very superior and satisfactory framework for switchboards.

The switches, fuse blocks, etc., are of the standard

S.K.C. type. They are independently mounted on the switchboard, which permits of great interchangeability of all parts of the board.

From the preceding account it will be noted that every part of the alternating system of the Royal Electric Company was rearranged and redesigned. The lines and circuits were rearranged to overcome objectionable inductive effects and to transform them from single to double phase circuits. 1,161 old transformers were replaced by 628 new transformers with a reduction in leakage load of 245 amperes. Eighteen old style single phase generators, with their revolving wire on the armatures, collector brushes and rings, their numerous belts, pulleys and line shaftings, were replaced by five S.K.C. generators of the inductor two phase type, the latter being belted directly to the engines. The old wooden single phase board was replaced by a new fire-proof two phase board designed to distribute current for light and power from the same circuit.

QUESTIONS AND ANSWERS.

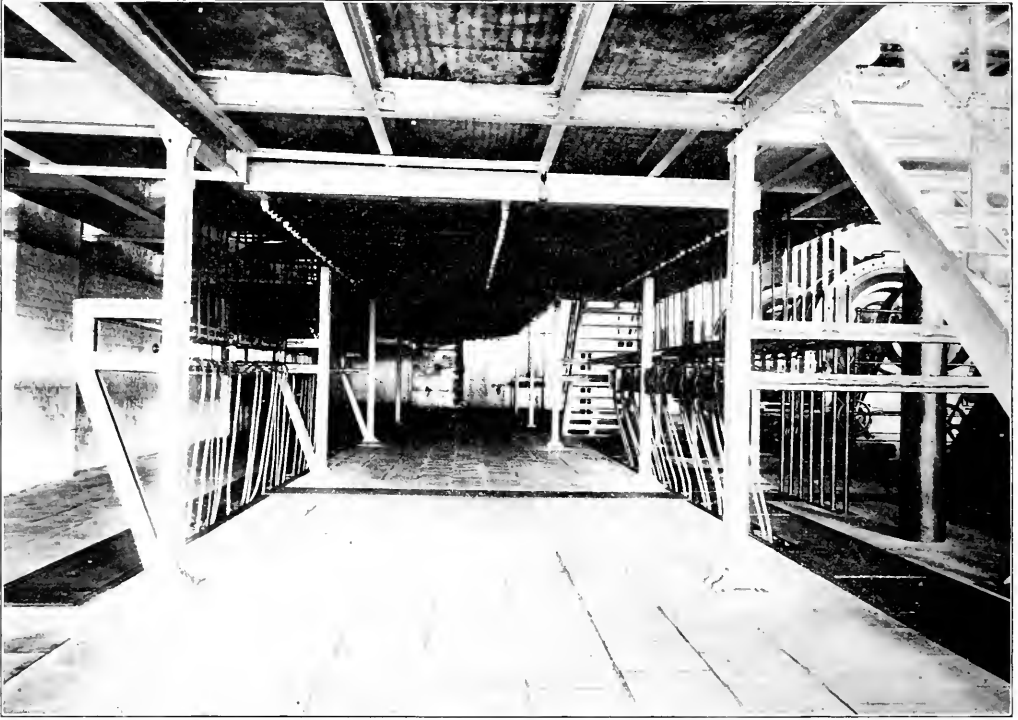
H. K., Walkerville, Ont., writes: "What kind of safety valve would you recommend for a stationary boiler—a lever valve or a spring or pop valve?"

ANSWER.—A lever valve is recommended for simplicity, and also for efficiency. It should be carefully set, and the weight absolutely fixed in position so it cannot move. The valve should also be operated now and again, both by raising steam to blowing point, and also by hand at lower pressures, in order to ensure its not sticking to the seat.

POINTS ON SHAFTING.

The author of a paper on "Shafting in Factories," presented before the American Society of Mechanical Engineers, summarizes his conclusions on the subject as follows:

It seems to the writer that in ordinary machinery es-



SPACE UNDERNEATH SWITCH-BOARD, SHOWING WIRES FROM GENERATORS, ROYAL ELECTRIC COMPANY'S ALTERNATING LIGHTING STATION, MONTREAL.

All of this reconstruction has been designed and carried out on plans which adapt the system to be served either from its existing steam plant or from the Chambly water power plant. Upon the delivery of power from Chambly, the five 300 k.w. generators recently installed will be used as synchronous motors, from which will be operated the D.C. arc machines.

The system affected by the above-described changes, operating for five months under the old conditions, from Oct. 1, '94, to March 1, '95, consumed 2,931 tons of coal more than was consumed in the five months from Oct. 1, '96, to March 1, '97, the number of incandescent lights being 10,200 more during the latter than during the former period.

ALL RIGHT.

Mr. S. H. Reesor, proprietor of the St. Mary's Electric Light Co., writes: "Enclosed please find \$1.00, subscription to the ELECTRICAL NEWS. Your paper is all right."

establishments an observance of the following rules might effect a saving that would be noticeable in the annual balance.

1. Use pulleys of large diameter on counters and narrow fast-running belts.
2. Use nothing but the best oil and plenty of it, catching all drip, and either purifying it or using it for some other purpose.
3. Have all the shafting and counters oiled regularly and do not depend too much on automatic oiling.
4. Inspect line shafts from time to time, and see that they are in line and can be turned easily.

Many line shaft boxes bind at the sides when screwed down, sometimes increasing the turning moment 100 per cent.

The town of Fort William, Ont., is obtaining estimates for an electric light plant.

The Bushnell Oil Company has purchased the Alpha Refining Works at Sarnia, Ont., and will reconstruct and modernize the plant.

CANADIAN ELECTRICAL ASSOCIATION.

SOME PARTICULARS OF THE APPROACHING ANNUAL CONVENTION.

SINCE the announcement in our last issue of the dates selected for the convention of the Canadian Electrical Association at Niagara Falls—viz., the 2nd, 3rd and 4th of June—very satisfactory progress has been made with the arrangements. A meeting of the Committee on Arrangements was held at Niagara on March 27th, at which there was a full attendance. A very satisfactory programme was drafted, and sub-committees appointed to perfect details and complete necessary arrangements.

Pending the completion of arrangements, it is not possible in this number to give the programme in detail. This much may be said, however, that satisfactory

interest and value in those which shall be presented. Several of the papers which have been arranged for and are in course of preparation are in hands which leave no room to doubt that this aim will be reached. The subjects of these papers have been chosen with a view to interest and instruct persons connected with every branch of electrical work. It should be borne in mind, however, that the most instructive part of the proceedings of a convention of this kind should be the discussions upon the papers. There was a marked improvement in this particular noticeable at the last convention, and it is greatly to be desired that members will go to the coming convention prepared to enter actively into the discussion of the points brought out by the authors of the various papers. A comparison of notes and experiences at gatherings of this sort is most helpful.



NIAGARA FALLS—SCENE OF THE CONVENTION OF THE CANADIAN ELECTRICAL ASSOCIATION ON JUNE 2, 3 AND 4, 1897.

terms have been made with the proprietors of the new Hotel Lafayette for the accommodation of members and friends of the Association while in attendance on the convention. This hotel has been recently erected, is most comfortably fitted up with all modern appointments, and is situated directly opposite the Suspension Bridge, presenting an excellent view of the great cataract.

The sessions of the convention will be held in the Assembly Hall of the Dufferin Cafe' in Queen Victoria Park, where the annual Association Banquet will also take place on the evening of the second day.

It is the purpose to compress the business of the convention into the first two days, leaving the third day entirely free for sight-seeing. With this object in view the number of papers will be somewhat reduced, and an effort made to secure the highest possible standard of

It is understood to be the intention to introduce a new feature at the coming convention, in the shape of a "Question Box." Members are invited to forward to the Secretary at any time prior to the date of the convention, but preferably as soon as possible, questions on any electrical subject on which they may desire information, and answers will, if possible, be given at the convention.

Mention is made elsewhere of matters which at present should have a vital interest for the owners of central stations, and upon which we hope to see action taken at this convention. The time has arrived when central station owners in Canada should get together and give united consideration to legislation and other matters affecting their interests. In the Canadian Electrical Association they have an organization able and willing to be of service in this direction. It only remains for

those who should be most interested to connect themselves with the organization, and strengthen its hands for this particular work.

So much for the practical business aspect of the convention. From the standpoint of interesting sight-seeing and pleasure, there is assurance that this convention will be a most attractive one. The natural beauties of Niagara—electric railways on either side of the Niagara gorge—one skirting the river bank, the other far down the side of the precipice near to the boiling current; the wonderful generating plant of the Cataract Construction Co.; the acetylene gas and electro-chemical works; the system in use for the transmission of power to Buffalo; the electric railway connecting the Falls with Buffalo—all these and more will be open for the inspection of the visitors—forming a combination of interesting sights such as cannot be witnessed elsewhere in the world.

A special committee has been appointed to provide for the annual banquet to members and invited guests on the evening of June 3rd, and it can confidently be promised that the affair will be thoroughly first-class and enjoyable. The catering will be in the hands of Mr. Barnett, proprietor of the Dufferin Cafe', and late of the House of Commons restaurant at Ottawa, of whose ability there can be no question.

Persons connected with the electrical interests who have not yet connected themselves with the Canadian Electrical Association should lose no time in doing so. There should be a large turn-out of such persons, as well as of present members, at Niagara on June 2nd, 3rd and 4th.

PERSONAL.

Mr. James Yuill, formerly city electrician of Winnipeg, died in that city last month. He was at one time a resident of Montreal.

Mr. J. W. Moyes, manager of the Metropolitan street railway, lately returned from the United States, where he arranged for the new rolling stock required by the company.

Mr. Thomas W. Lester, ex-president of the Hamilton, Grimsby and Beamsville Electric Railway, was recently married to Miss Emma Springer, daughter of the late Dr. Springer.

Mr. W. G. Blackgrove, who for many years had charge of the steam plant at the James Morrison Brass Co.'s works, has accepted a position as traveller for Wm. C. Wilson & Co., steamboat, railroad and mill supplies, Toronto.

Mr. J. A. Rutherford, a native of Hamilton, Ont., and formerly with the Edison Co. in that city, after having been connected for a number of years with the Westinghouse Co. at Pittsburgh, has recently taken a position as salesman in the street railway department of the Johnston Company, at Johnstown, Pa.

Mr. D. C. Dewar, local manager of the Bell Telephone Company at Ottawa, has received promotion to the management of the Montreal office, and is succeeded by Mr. J. E. Macpherson, who has been travelling auditor of the company for eastern Ontario and Quebec. Mr. Dewar is well qualified to fill the responsible position to which he has been appointed.

Mr. J. J. Franklin, of Toronto, has been appointed secretary of the Rossland Board of Trade, and will shortly leave for that city. Mr. Franklin was for ten years superintendent of the Toronto Street Railway, and during his management the road was converted into an electric system. After leaving Toronto he went to Paris, where he organized a tramway service for an English syndicate. Latterly his attention has been devoted to securing a franchise for the Chatham City and Suburban Electric Railway Company.

The Electric Power Company, of Fraserville, Que., proposes to extend its telephone lines as far as Quebec.

The City Council of Waterloo have reached an agreement with the Waterloo Electric Light Company for lighting the town by electricity.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

MEETING TO DISCUSS LEGISLATION.

The stationary engineers have taken action in the direction of obtaining legislation from the Dominion government. On the 17th of March a committee of the Ontario Association conferred with a committee of Toronto No. 1, C. A. S. E., at Toronto, when it was resolved to ask for an inspection and license law. A sub-committee, consisting of Messrs. A. M. Wickens, of Toronto, A. E. Ames, of Brantford, and James Devlin, of Kingston, was appointed to proceed to Ottawa to explain the objects of the bill to Parliament, and to endeavor to secure its adoption. The draft bill to be presented will contain several important changes from that placed before the Ontario House recently. It is intended to exempt from the working of the law small steam plants, perhaps up to 15 h. p., to grant a permit to the older engineers to retain the positions held at the time the act becomes law, or to operate a similar plant, and to make such provision as will remove the opposition which has in the past been met with from saw mill owners, by allowing them a specified time in which to obtain the services of a licensed engineer. With these points overcome, it is hoped to obtain such a law as will elevate the standard of steam engineering and lessen the number of disastrous explosions which occur each year.

HAMILTON NO. 2.

An open meeting of the above association was held on the 19th of March. Mr. Ballard, Inspector of Public Schools, gave an interesting lecture on decimals and fractions. Mr. Edwards, architect, made a few remarks, and past-president W. G. Blackgrove, of the Executive Council, gave a short address. The certificates of membership were handed to the members by the president. Our annual dinner will take place on April 15th.

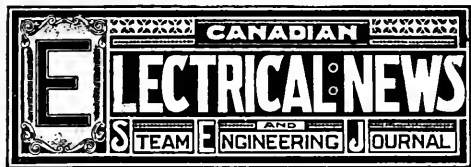
JOHN IRONSIDE, Rec.-Secretary.

LONDON NO. 5.

At the regular meeting of London No. 5, held on March 4th, a lively debate took place on "Strength of Steam Boilers," and some very interesting illustrations and calculations were made. The members were presented with certificates of membership.

An interesting feature of the meeting held on the 18th ultimo was a lecture by Mr. H. W. Page, of St. Mary's, on the regulator and the atmospheric governor. Mr. Page, who is a former Londoner, is the inventor of several engineering appliances, and his address was much appreciated. He congratulated the engineers upon the advancement made in late years in engineering science.

"Electric Transmission by Power," by Dr. Louis C. Bell, is a book containing upwards of 500 pages, with 230 illustrations. It describes in a very simple manner the fundamental facts concerning present practice in electrical power transmission, and shows by what processes the work is planned and carried out. The work is divided into thirteen chapters, in which is described and illustrated such apparatus as are typical of the methods used, rather than representative of any particular scheme of manufacture or fashion in design, making it especially valuable to students who desire to obtain knowledge regarding the principles of electrical construction. Price \$2.50. The W. J. Johnston Company, New York.



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SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 5 cents is added for cost of discount. Money sent in unregistered letters will be at sender's risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Study of Electricity.

It may serve a useful purpose to point out to intending students of electricity that a good knowledge of mathematics is a most essential requirement. The student who is not well grounded in mathematics would do well to properly equip himself in this direction before entering on an electrical course. Of the students who take this course in our scientific schools, at least thirty per cent. fail in their examinations through lack of the requisite knowledge of mathematics. It is safe to say that no young man who has not successfully mastered the mathematical problems presented to graduating students of the high schools can hope to succeed in an electrical course.

Enforced Cleanliness in Cars.

The cars of the Toronto Railway Company have for some time past carried placards requesting passengers to refrain from spitting on the floors. No doubt the principal object of the company in seeking to put a stop to this practice was to remove a cause of offense to the sensibilities and injury to the clothing of well-mannered passengers. There is, however, a more important phase of the subject, viz., the danger to health from exhalation of consumptive germs. Realizing the necessity of protecting the public from this danger, the Board of Health of New York have placed placards in the street and elevated cars of that city forbidding spitting on the floor. The Board of Health of Los Angeles, California, two years ago passed an ordinance against expectorating on the streets and in public places, but it is said that the measure has not been enforced. The danger from contact with consumptives is illustrated by the fact that in Southern California, which has been the resort of large numbers of persons afflicted with this

disease, the native population has become seriously affected. It is to be hoped that our Canadian railway companies and boards of Health will give the attention to this matter which its importance requires.

Methods of Interior Distribution.

An increasing number of large buildings are being equipped electrically, provision being made for the easy running of the distribution system by the installation of interior conduits during the progress of construction of the building. As a result several different forms of conduit are being placed on the market, presenting many different features. There is plain gas piping with rounded elbows, insulating piping, iron pipe with an insulating lining. But a great number of prominent electrical engineers have agreed that for all purposes the ordinary iron pipe is as good as can be used, the wire to be drawn into it being heavily insulated. It is interesting also to observe that alternating current wires are both drawn into the same tube, it having been found that the counter E. M. F. of induction (in the iron pipe) set up by using only one wire in the tube was very noticeable.

The Power of Electric Waves.

MR. W. H. Preece, chief of the electrical department of the British postal system, is said to have induced the British Government to undertake a test of the possibilities of a method of telegraphing without wires, invented by a young Italian named Guglielmo Marconi. By means of his apparatus, consisting of a transmitter and receiver, each about 15 in. \times 10 in. \times 8 in. in size, Marconi claims to have sent and received waves over or through a hill three-quarters of a mile in thickness, and over a distance of 100 yards through seven or eight thick walls of the general post office building in London. His belief is that by the method he is using electric waves can be transmitted through the air over a distance of at least 20 miles, and made to pass through all kinds of metals and solid substances. This discovery following close upon that of the Roentgen rays, opens to our view wondrous possibilities, and shows that in some respects electricity is indeed yet in its infancy.

Acetylene Gas.

NOTWITHSTANDING all unfavorable criticisms, which in great measure are founded on commercial rather than on scientific considerations, the manufacture of acetylene still continues, and it is only reasonable to admit that it has its field as an illuminant, and that in certain conditions it may compete favorably with electricity. At the same time it is doubtful whether, in the present state of its manufacture or use it can be said to be fully understood, its effects on the conduit for distributing it having yet to bear the test of time; and its physiological effects being rather startling in some cases. Professor Mosso, of Italy, has been recently conducting some researches into the action of the gas when leaking into the atmosphere, and found it strongly poisonous. Experimenting on animals—dogs, cats, birds, etc.—he found that a small quantity in the air or inhaled in the blood is followed by death, directly attributable to it; a mixture of 20 per cent. acetylene (which is, of course, larger than would ever probably be an actual case) in the air was followed by death in one hour. The effects of a small leak, while not probably

being necessarily fatal, might, at least, be the permanent injury of some of the respiratory organs.

Transformers.

THERE can be no question of greater importance to a central station than the class of transformers used and their distribution. Their selection on the basis of price only is a mistake that is of too frequent occurrence, and that results in loss direct and indirect. Their regulation is a matter that is of importance directly to the consumer, and indirectly to the central station, as anything unsatisfactory in the service naturally reacts at once on receipts. The magnetizing currents and core losses are felt directly by the coal pile, and in very appreciable amounts. A very prominently known transformer of 6,000 watt capacity, has a magnetizing current of .06 amp. on a 2,000 volt circuit; anyone can figure for himself what this means in point of coal consumption during a year, and multiplied by the number of transformers gives the total consumption owing solely to this cause. It is also easy to calculate how much more coal would be consumed by a transformer of same capacity having a magnetizing current of .1 amp. or .04 amp. greater than in the above case. A few such calculations will go very far towards proving in a plain arithmetical manner how very extravagant a cheap transformer can be, and per contra that a good one is worth money.

Municipal Lighting.

A BILL now before the Ontario Legislature gives municipalities of less than 5,000 inhabitants the power to issue 30 year debentures for the purchase of electric lighting apparatus. The bill received considerable opposition in committee on the ground that the life of an electric plant is at longest twenty years, and that the time at which the debentures should mature should correspond to that at which the investment representing the proceeds of such debentures would be wiped out. The advocates of the measure urged 30 years on the ground that this would correspond with the period allowed for water works debentures, and would enable small municipalities which could not afford to construct and operate water works alone, to reduce the operating cost by combining with the water works electric lighting. The mayors of several interested municipalities appeared before the committee to urge the passing of the measure. The owners and managers of electric lighting companies should be able to see in this legislation the trend of events, the manner in which their interests are likely to be affected, and the necessity for greater watchfulness and united effort in the direction of self protection. The Canadian Electrical Association has done, and is doing, what it can to guard the interests of the electrical companies against hostile legislation. If the electrical companies whose interests it is looking after will give the Association their united and hearty support, a great deal may be done to protect the investments of those engaged in the electrical business. One thing to our mind appears clear, viz., that legislation should at once be enacted compelling municipalities who may desire to do their own lighting to purchase by arbitration the plant of the existing private company. If this is not done, hundreds of thousands of dollars of private capital invested in electrical machinery will be wiped out of existence. An electric lighting company differs from other manufacturing companies in this, that it

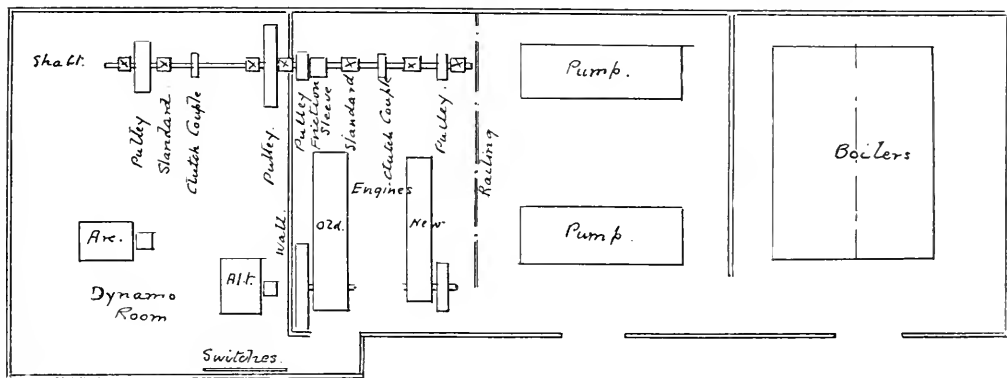
cannot easily change its location. Each town has its own lighting company, whose plant has been purchased with a view to the special requirements of a particular locality there would be difficulty in finding another opening were the company forced to change their location, and if an opening were found, much of the apparatus would become valueless, in as much as it could not be adapted to the new conditions, and a large amount of new material would have to be purchased. For this difficulty of making a change of location is due the fact that prices for electric lighting have been forced down far below a fair basis. The municipalities have known the disadvantage at which they held the companies, and have not been slow to take advantage of it. It is time, as already stated, that those who have invested their means in the electrical business should awake to united effort for their self protection.

THE MUNICIPAL ELECTRIC LIGHTING PLANT AT GODERICH, ONT.

[CONTRIBUTED.]

NOTWITHSTANDING the many strong arguments urged by political economists against the morality and advisability of municipal control of electric lighting and waterworks services, the great public, who is the final court of appeal in such matters, has

for the purchase of the necessary machines. The corporation engaged the services of Mr. G. White-Fraser, consulting electrical engineer, Toronto, to take entire charge of the work, and all plans, specifications, etc., for steam and electrical apparatus were drawn by him, and the work done under his personal supervision. They took the very sensible view that if they engaged an engineer at all they had better take his advice and be guided by him in technical matters, and the result is that every day proves the wisdom of such a course. The waterworks building is on the lake side, the town itself being on the high level of the surrounding country about 250 to 300 feet above this, the power house about 3,000 feet from the Square, and the town spreading out half to three-quarters of a mile on every side. An engine of nominal 60 h.p. used to run the two arc machines, being belted to a light shafting placed on brackets near the ceiling of the pump room, which in its turn was belted to the arcs. It was decided to purchase a 30 ampere, 2,000 volt (nominal 1,000 light) alternator, and to replace the commercial arcs by incandescent; thus the steam power required must be enough to run the alternator and the 35-light 2,000 c.p. arc together. An offer was received from the engine builders to take out the old engine and to put back on the same foundation one new one powerful enough to do the combined service, but it was decided that to do so would result in great inefficiency in operating, as there would be times when the arcs were not in and when the alternator had only about a quarter load, and then the 150 h.p. engine would be running only 25 h.p., or 17% load. Therefore the old engine, which required only some slight repairs to put it in excellent condition, was speeded up to about 100 r.p.m., which brought up its capacity to about 85 h.p.



MUNICIPAL ELECTRIC LIGHTING PLANT AT GODERICH, ONT.

decided in its favor in several instances recently; and so far the results seem to have justified the decision. The town of Goderich in western Ontario is perhaps the most prominent example, for the reason that it possesses a population of nearly 5,000, is a county town, a railway terminus, and is growing rapidly in importance as a manufacturing center. Goderich was one of the earliest towns established by the Canada Company, and is most attractively laid out, the streets radiating from a central space, the center of which is occupied by the County Buildings, and being broad and level. A number of the old well-known Ontario families originated here, their residences being built solidly in the "Colonial" style, and standing in beautiful grounds laid out in parterres and orchards. The business part of the town is mostly around the central space or "Square," as also are the large hotels, the opera house, two banks, and various offices, lodge rooms, etc. There are numerous large and handsome churches; the Roman Catholic and English churches, both beautifully lighted, and others to follow. The private residences, as might be expected in a town of such importance, are of a most superior character, and as the corporation has exercised the most careful and minute supervision over every detail of installation, inspecting wiring work, equalizing pressures and watching the interests of its customers, the light is every day growing in popularity and the business greatly increasing. A waterworks system was put in some years ago, to which was shortly added a street and commercial arc system, the former of 2,000 and the latter of 1,200 candle power arcs. Within the last four years numerous applications were made to the Council for franchises for the incandescent lighting of the town, but it was eventually decided to take a vote on the subject, and the rate-payers in August last year authorized the expenditure of \$6,500

at quarter cut-off 80 lb. steam. A smaller engine of 35 rated h.p. at quarter cut-off 80 lb. was purchased and placed in the position indicated in the diagram, which had previously been occupied by the two arc machines. The foundations for the new engine and new shafting were excavated and built without interfering with the regular arc service, as the machines were lifted off the floor on beams, and so operated off the old shafting until the building extension and the new shafting had been completed, when they were moved out to allow of the new engine being placed. Ultimately, the whole arrangement was as shown in diagram, room being left for the addition of more steam and electric machinery when conditions required it. The shafting is of peculiar interest, as the arrangement of clutches permits the throwing in or out of either engine or dynamo, so that no more engine capacity is running at any time than the actual load requires. Finally, the two engines were so piped that they can either exhaust free or be run condensing with the pump's condenser. (Diagram 1.)

The entire wiring system has been so designed as to secure three very important advantages: Very low drop; perfect equality of pressure everywhere; and extreme simplicity. The total drop allowed between generator and lamps is less than 5%, a considerable proportion of this being on the feeders between generator and main distributing center on the Square. The primary system is two-wire, a single-phase alternator having been installed; while the entire secondary system is 3-wire with banked transformers, wires being interconnected at corners so as to form a network. An interesting feature is that the connections are made at the back of the houses on the Square, the poles being placed in back-yards, and the wires, etc., not disfiguring the street. The wiring system was designed with a view to the ulti-

mate requirements of the town, and not merely to meet the present demand; hence there is a unity and coherence of plan not possible where small additions are made from time to time without reference to the whole. It was thought a more economical and efficient arrangement to spend money in copper and so greatly reduce the drop, than to save a little in wire and spend more in coal; therefore both primaries and secondaries are large in proportion to the distance and amperage. A feature of special importance to a power plant where fuel is expensive is the house-wiring and kind of lamp used, and this was wisely paid special attention to. A separate specification was drawn up by the engineer covering all installation details, such as class of material, maximum allowable drop between lamps; make, wattage and voltage of lamps, etc.; and separate tenders were called for on these specifications, the successful tenderer having to place a 5% cheque as guarantee, and being required to furnish a wiring plan of each installation for the approval of the engineer before being allowed to proceed. The public was then notified through the papers that no installation that had not been passed by the engineer would be accepted, nor current turned on. The result was that irresponsible wiring contractors were excluded; that all houses were wired on a coherent plan, and everything under the eye of the engineer—carrying out his general designs, the public also being protected against incompetent wiremen.

Many radical departures from hitherto accepted practice were made in the purchase of entire plant. In the first place, separate specifications were drawn up for (a) steam engine and shafting completely installed as per plans; (b) generator and instruments completely installed ready for test; and (d) house-wiring of not less than 500 lights, including lamps, sockets, labor, material, etc., at so much per light. The engine was specified as a certain h.p. at a given steam and a given cut-off, and a maximum speed regulation was laid down; it was also a condition that a test would be made of a certain duration, during which cards would be taken to prove h.p., regulation and valve adjustments, etc. The generator specification was perhaps that one which differed most from accepted practice, in that, without mentioning lamp capacity, it specified a certain amperage, certain voltage, certain voltage increase for full load, certain maximum allowable temperature, increase, etc., and it was specified that the test should consist of a run of 12 consecutive hours, during eight of which the amperes and volts must be so much, and during the other four they must be so much more, and in excess of the lamp requirements. The transformers were also specified in watts (not lamp capacity), and data was called for as to voltage drop, magnetizing currents, full, half and quarter-load efficiencies.

A considerable number of tenders were received, and as the conditions were the same for all—failure to meet guarantees entailing absolute rejection of plant and loss of deposit, etc.—it was felt that selection should be largely based on price. This was the principal basis of comparison, taking of course into careful consideration little differences of efficiencies, heating limits, etc., and assigning to them their money value. After reducing all to precisely the same basis of kilowattage, efficiency, heating, regulation, etc., taking also into account probable freedom from repairs, ease of effecting repairs, etc., the generator contract was awarded to the National Electric Co., of Eau-Claire, Wisconsin; the transformers to the Packard Electric Co., of St. Catharines; the wiring contract to the Rogers Electric Co., of London, and the engine and shafting to the Goldie & McCulloch Co., of Galt.

On October 21st and 22nd the entire plant was tested in accordance with the terms of the specifications. The engine was run for some time with and without load, and numerous cards taken; each friction or other clutch was examined and tested. As there were only some 200 lights wired up, not giving a full load for the machine, a water rheostat was constructed, and for 12 consecutive hours it was run on this load, temperature being previously taken. The test was conducted by Mr. Fraser, representatives of the National Electric Co. and of the Goldie & McCulloch Co. being present, and members of the waterworks and light committees. After shutting down, the temperature of armature, field coils and cores, commutator, etc., were taken, and the power dissipated through the water load checked against the temperature of feed water and the amount evaporated.

This is probably the first complete plant in Ontario that has been specified, purchased, installed and tested on the above system, and the results seem to justify it. The lights all over town are of equal brightness, drops being small and the transformer capacity greatly economized. Although the plant was started only in October, 1896, there are now 1,250 lamps wired

up, and orders coming in steadily. The rate schedule is of itself sufficiently interesting to mark out this plant as standing almost alone in cheapness. There are no meters as yet. The rates are as follows:—

For commercial lamps in stores.....	45 cents per month per lamp
For residences, up to 5 lamps.....	30 " " "
" " 6 and 7 lamps.....	29 " " "
" " 8 and 9 lamps.....	28 " " "
" " 10 and 11 lamps.....	27 " " "
" " 12, 13 and 14 lamps.....	26 " " "
" " 15 lamps.....	25 " " "

For over 15 lamps, 20 cents each, with a minimum of \$3.75 per month. Hotels—Bedrooms and dining room at residence rates; bar office, halls, etc., at commercial rates. Churches and halls—\$1.50 per lamp per year, with 10% discount for prompt payments. And these rates are expected to cover all expenses, including interest on debentures, sinking fund, depreciation, etc. The plant was installed during the mayoralty of Dr. Shannon, with Mr. P. Holt as chairman of the Waterworks and Light Committee, and Mr. W. H. Smith as engineer of the waterworks, who is responsible for operating and upkeep.

SPARKS.

The corporation of Liverpool, Eng., has purchased the assets of the United Tramways & Omnibus Co.

The town council of Port Hope, Ont., have invited tenders for lighting the streets by gas or electric light.

The St. Catharines Electric Light Co. will increase their capacity by installing an additional water wheel.

Messrs. Cooke & Son, of St. Catharines, will at once install an incandescent plant, and water wheels with which to operate the same.

The village council of Weston have extended the date for the completion of the Toronto and Suburban Street railway until the 30th of June.

Mayor Marks, of Port Arthur, Ont., has been granted permission by the Ontario government to purchase an electric light plant for lighting the streets of the town.

The Fort Erie Electric Railway Company have asked for and obtained permission from the Ontario legislature to run from Fort Erie to Chippawa, and from Crystal Beach to Ridgeway, and to operate their cars on Sunday.

Mr. C. R. Hosmer, manager of the C. P. R. telegraph systems, expresses his belief that the Pacific cable enterprise will be brought to a successful issue, and that if the cable is not laid from Vancouver it will be laid from some other point.

The Toronto Electric Light Company are rapidly extending their incandescent lighting business—a large demand coming from the principal hotels. The company are said to be at present installing incandescent lamps for new customers at the rate of 300 lamps per week.

At the convention of the National Electric Light Association of the United States which is to meet at Niagara Falls, N. Y., on the 8th of June, Prof. Carus Wilson, of the Electrical Department of McGill University, Montreal, will present a paper on "The Induction Factor, a New Basis of Dynamo Calculation and Classification."

The application of Edward Jemson and others to the Ontario Legislature for the right to develop the water power of the Kakabeka Falls, with the object of supplying electric light and power to Fort William and Port Arthur, is meeting with opposition from a Philadelphia company owning property on the river immediately below the falls.

A proposition has been made to generate power required for lighting the new municipal buildings in Toronto at the waterworks pumping station. The architect advised that an electric plant be erected at the buildings, but it is claimed that by putting in a large dynamo and utilizing the boiler power at the pumping station, a large saving to the city in operating expenses would be effected.

The Hull, St. Louis Dam and Victoria Springs Railway Company are seeking a broad gauge charter from the Ontario government. The promoters are Ottawa capitalists, who propose constructing an electric railway around the city. The first section will be built from Cumming's Bridge to the Victoria Springs, a distance of six miles. Following this there will be a belt line around the city to St. Louis Dam and other suburbs. The capital stock of the company is placed at \$1,000,000. T. G. Brigham is acting solicitor.

SPARKS.

The council of Richmond, Que., has asked tenders for electric street lighting.

The Roberval Electric Light Company has been organized at Roberval, Que.

The town of Huntsville, Ont., has taken over the electric light plant from W. S. Shaw.

The electric railway at Sherbrooke, Que., is expected to be in operation by August next.

The Ottawa Electric Railway Company intend erecting a pavilion at the west end park, to cost \$10,000.

The Windsor Electric Light and Power Company, of Windsor, N. S., will shortly erect a large brick chimney.

The Nova Scotia Telephone Company will replace the present line between Amherst and Truro with a metallic line.

The Royal Electric Co., of Montreal, have put a new switch-board in the electric light station at Sherbrooke, Que.

The Preston and Berlin Street Railway Company are asking for an extension of time for the commencement and completion of the road.

The electric light company at Barrie, Ont., have asked the town to purchase their plant at a valuation, or to give a ten years' franchise.

Mr. Ormond Higman, chief electrician of the Inland Revenue Department, Ottawa, recently gave an interesting exhibition of the Roentgen rays at Government House.

Edward Lachapelle has taken an action against the Ottawa Electric Co., claiming \$5,000 damages for injuries alleged to have been sustained by falling from an electric light pole.

Foss & Davis, proprietors of the Eastern Townships Electric and Machine Works, Sherbrooke, Que., have dissolved partnership. The business will be continued by Geo. F. Foss.

The Nanaimo-Alberni Railway Company, composed of Andrew Haslam, R. E. McKechnie, and others, of Nanaimo, propose to construct railways and operate telegraph and telephone lines.

W. H. Brandon and C. K. Hammond, of Brandon, B. C., and R. B. Kerr, of New Denver, are asking authority from the British Columbia government to supply electric light and power.

Recently some subscribers of the Bell Telephone Company at Brockville were connected with the Queen's Theatre, Montreal, and were treated to the performance over the long-distance wire.

The Cataract Power Company, of Hamilton, have surveyors at work taking levels in the vicinity of DeCew Falls, and it is stated that the work of developing the power will be commenced shortly.

The directors of the Hamilton, Grimsby and Beamsville Railway contemplate erecting new stations at Grimsby Park and Beamsville, and will purchase a large new car specially adapted for the summer traffic.

A comparative statement of the Montreal Street Railway earnings for the first five months of the fiscal year has been issued. The total earnings for February were \$8,995.68, an increase of \$2,557.39 over February, 1896.

The town council of Portage la Prairie, Man., lately engaged Mr. J. F. Fanning, of Minneapolis, to report on a slough flooding and water power project. The total cost of the work is placed at \$100,000, including \$15,000 for a power house.

A threatened strike of the employees of the Birmingham, Eng., street railway is reported. This road was recently secured by a syndicate of Canadians, at the head of which is Mr. William McKenzie, of the Toronto Railway Company.

The Toronto Street Railway Company has submitted to the City Engineer its annual statement of rolling stock, etc. There are 221 motors, 180 large trailers, 42 small trailers, 9 sweepers, 12 snow plows, and 40 busses in the car equipment.

The Revelstoke Waterworks, Electric Light and Power Company, of Revelstoke, B. C., is seeking incorporation, to develop light and power. The applicants are John Abraham, Thomas Downs, Wm. M. Brown and Mr. Cowan; capital \$50,000.

The Quebec Electric Railway Company have purchased the rights and privileges of the St. John Street Railway Company and will assume charge on the 1st of May. The company has awarded the contract for trolley cross-arms to J. H. Gignac, for the sum of \$3,500.

Andrew Holland, Thomas Askwith, J. A. Trudeau, and others, of Ottawa, are seeking incorporation as the Dominion Electric

Heating and Supply Company, with a capital stock of \$100,000. The objects are to manufacture electric heaters and other electrical appliances.

Letters of incorporation have been granted to W. Sutton, W. P. Sutton, G. Philip, W. K. Anderson and F. B. Denton, of Toronto, as the William Sutton Compound Company of Toronto, with a capital stock of \$10,000, the object being to manufacture general engineers' supplies.

The Halifax Electric Tramway Company have acquired the entire street railway and electric lighting business of the city of Halifax, N. S. A modern power house has been erected, and the result of the first six months' operation shows gross earnings of \$87,882.23. The assets of the company are valued at \$1,360,000.

The first meeting of the shareholders of the Hamilton, Chedoke and Ancaster Electric Railway was held March 15th. A resolution was passed to obtain the necessary powers from the legislature to extend the road to Brantford and to increase the capital stock. The cost of the extension, it was calculated, would be about \$200,000.

Mr. B. S. Jenkins, superintendent of Canadian Pacific Telegraph, with headquarters at Winnipeg, states that important improvements are contemplated during the coming summer. New wires will be strung from Winnipeg eastward to Fort William; from Winnipeg westward on the main line, and south-west on the Pembina branch.

Incorporation has been granted to the Mineral and Timber Electric Railway Company, to construct an electric railway from Sudbury to Chelmsford, Nipissing, a distance of 20 miles, the work to be commenced within one year and completed within three. Among the promoters are Thos. M. Kirkwood and Killain McKinnon, of Sudbury.

Under the provisions of the General Electric Railway Act of 1895, the running of street cars on Sunday is prohibited, but the courts have held that companies incorporated before that time do not come under the provisions of the Act. The South Essex Electric Railway Company, which proposes to construct an electric railway from Windsor to Sandwich, thence to Amherstburg, Kingsville and Leamington, therefore requested permission from the Ontario government to operate their system on Sunday. The application was, however, refused by the Railway Committee.

The city of Chatham, Ont., is said to have reached an agreement with Mr. L. E. Myers, of Chicago, representing a syndicate of capitalists, for the construction of the Chatham City and Suburban Electric Railway. Mr. Myers agrees to construct a line of railway beginning at Third and King streets, and traversing King, William and Queen streets, to the city limits, thence to Cedar Springs and the lakes, also to install an electric light plant for furnishing electric light for public and private purposes. The lights are to be in operation by 1st September next, and the railway by first January, 1898.

A telephone cable has been laid across the inlet between Moodyville and Vancouver by the New Westminster and Burrard Inlet Telephone Company, under the supervision of Mr. H. W. Kent. The cable crosses the inlet from Hastings to a point directly opposite, and is about a mile in length. For the purpose a scow was fitted up with a reel for paying out the cable. By an ingenious arrangement attached to the cable reel it was possible to communicate by telephone from the cable scow to the shore while the cable was being laid, and thus a thorough test was made of the cable. The time occupied in laying the cable was less than three-quarters of an hour.

The city engineer of Toronto was instructed to report on the merits of the Wilhelm and Strowger automatic telephones, offers having been received to install these systems in Toronto. In this connection he visited several cities in the United States. The Strowger, he says, is a good deal of a novelty, and he watched its operation at Albion, a town where some sixty-four telephones are in use. It is, he says, excellent for a small number of subscribers, but he is not prepared to say whether it would serve the needs of a great city with some 5,000 to 6,000 telephones. There is no operator for the Strowger, but a key-board, with the numbers one to nine and an indicator. To get 234, or any similar combination of numbers, one must set the indicator opposite these numbers. Critics of the system state that it would take some 60,000,000 connecting wires to give a circuit of as many telephones as Toronto would require, and this, it was asserted, would be vastly more costly than operators.

A SHIFTED ECCENTRIC.

BY CAPT. JAMES WRIGHT, Montreal.

SOME time ago an automatic engine in this city that had formerly worked to the satisfaction of all concerned, began to fail, and got worse and worse. The owner rented power to six tenants, each one taking his quota from the main shaft, and the pulleys for the purpose required were sized to agree with an engine speed of 75 revolutions per minute.

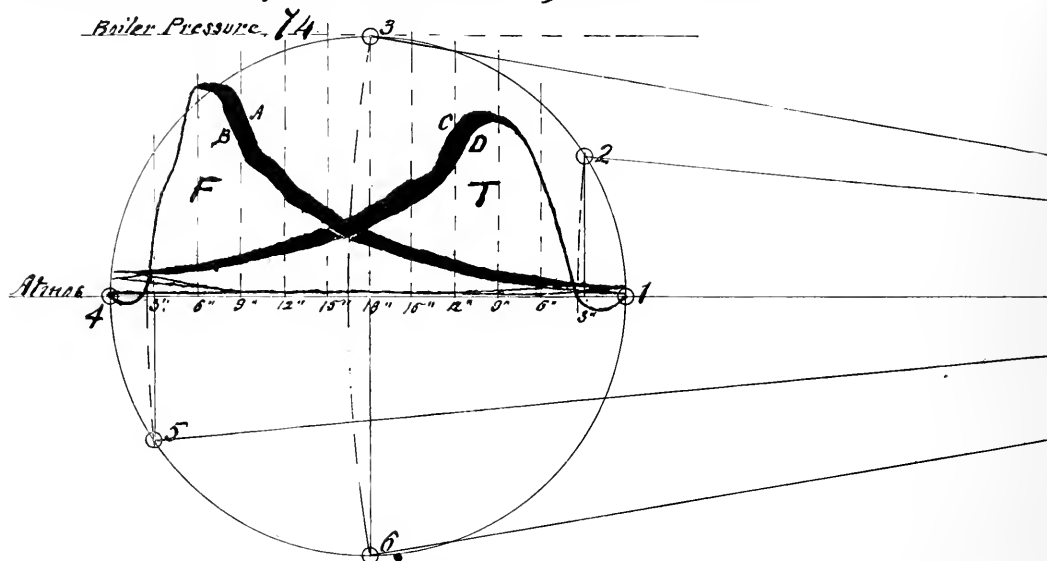
It had got so that the engine could not keep up speed if more

shading. This space in the originals was covered with expansion curves impossible to separate.

The characteristics of a good diagram from an automatic engine are:

- 1st. That the admission line from the beginning of the stroke to cut-off should closely approach the boiler pressure.
- 2nd. That cut-off should be as sudden as possible.
- 3rd. That at any point in the expansion curve the same weight of steam is practically accounted for.

FIG. 1. First Diagram - 9+30 A.M. Jan. 3rd 1896. Scale 40



than half the work was put on. For a couple of days complaints from the tenants were in order. The owner was willing to do anything required. A man from a shop tinkered the governor; another recommended reboring of the cylinders; an "expert" looked wise and gave a heap of good advice. After all, no improvement had been effected, and tenants said it was going from bad to worse. Some acquaintance of the owner suggested that the indicator should be used. When this had been decided the cylinder was piped in such a manner that indicators at each end of the cylinder could be simultaneously operated. When only one indicator is used on an engine that is subject to great and sudden changes in load, the obtained data may, in many respects, be misleading.

Fig. 1 was the first diagram taken. A glance proves that the eccentric has slipped backward on the shaft.

In taking the accompanying diagrams a patent reducer simultaneously operated the paper barrels of both indicators. It follows, that if the length of the diagrams is divided into any number of equal parts by ordinates or lines drawn perpendicular to the atmospheric line, each division accurately represents, on the reduced scale of the diagram, a uniform amount of travel of the piston while a stroke was being made; and also the effective pressure of the steam on the piston during each division can be read with the scale of the spring in use.

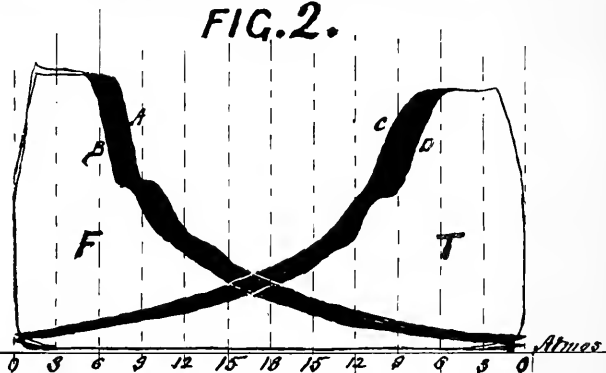
In practice it is convenient to make the number of divisions a multiple of the inches in the stroke—that is a number which divides it without a remainder. In this case there are twelve divisions, and each one equals three inches of the stroke. In all of the figures F is the stroke from the crank and T towards.

In Figs. 1, 2 and 3 the pencil was kept on the paper during 50 revolutions. The variations in work done are shown in dark

4th. Sufficient exhaust lead to permit the cylinder to discharge its contents before, or immediately after the beginning of the return stroke, and followed with a back pressure not exceeding one or two pounds.

5th. Compression or cushioning; this is a debated quantity, but in any case should, at least, be sufficient to prove that the exhaust port had been closed previous to the end of the stroke.

Eccentric moved ahead. 9+53 A.M. Scale 40. FIG. 2.



In diagram T on Fig. 1 the steam stroke begins at the right hand end of the atmospheric line. I read on the diagram that during the first $3\frac{1}{2}$ inches of the stroke the pressure was below the atmospheric. From this point it slowly rises up to 34 pounds at the sixth inch, 51 pounds at the ninth, and 52 pounds at the tenth inch of the stroke, which is the highest attained, and is 22 pounds below the boiler pressure. Complete cut-off takes place at the 12th inch, when expansion sets in and is continued to the end of the stroke with the exhaust port still closed. At the ninth inch of the return or exhaust stroke the back pressure settles down to $1\frac{1}{2}$ pounds. This is carried to the end of the stroke, where there is

no appearance of cushioning. In this manner the other diagrams can be read. The mean indicated work of both strokes is 37 h.p.

Both of these diagrams show that the steam port was slightly open at the fourth inch of the stroke. The engine was stopped and moved into this position. A convenient point of greatest travel in the valve gear was selected, and its distance from a suitable stationary point was accurately measured. The engine was then moved back to the dead centre, or the beginning of the stroke, and the eccentric was turned ahead on the shaft until the valve gear was brought into the same position that it formerly occupied, at the fourth inch of the stroke. The engine was started. Tenants were asked to put on work as they pleased, and the diagrams on Fig. 2 were taken. Here the admission pressure is close to the boiler pressure, and the terminal pressure is about the same as on Fig. 1. Although the work is now 60 h.p., or 23 h. p. greater than in Fig. 1 (the engineer will perceive that the weight of steam accounted for by the indicator is practically the same in both), still the opening of the steam port is slightly late; so is the opening and closing of the exhaust port.

The engine was stopped again, and the eccentric was moved ahead 3-16ths of an inch on the shaft. The tenants were asked to put on all the work they could, and crowd it. The diagrams on Fig. 3 were then taken. During this time the engine worked at an average of 84 h. p. The action of the valve gear is now good, except that steam is carried farther on one stroke than on the other. This was a simple matter to correct, and without stopping the engine. A few minutes before 12 M., and with a falling pressure of steam in the boiler, Fig. 4, a single revolution diagram was taken. This was considered final.

It will be observed in Fig. 3 that in the diagram lettered E E, tripping did not take place. The result is surprising. Compared with the diagram lettered C, which has the greatest charge of steam, the engine could take and trip, the diagram E E accounts for the consumption of 82% more steam and only 18% more work.

The circle and lines on Fig. 1 in conjunction with the stroke scale, is a simple method of representing on a diagram or a sheet of paper, the relative position of a crank pin and piston at any point of the stroke.

THE STEAM ENGINE INDICATOR.*

By JOHN McEWEEN.

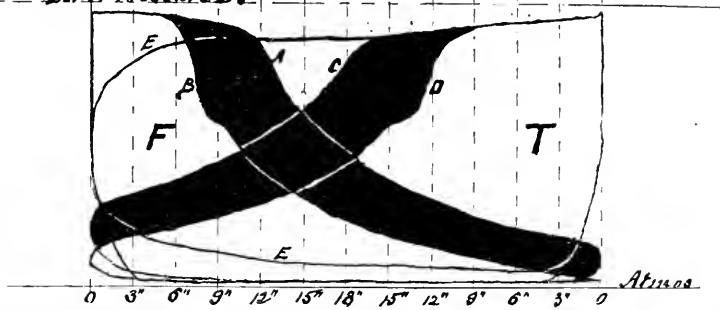
The steam engine indicator is an instrument for drawing a diagram, on paper, which will accurately represent the various

their indications were often misleading, and of little use beyond showing the points in the stroke at which the valves opened and closed—a service of great value, but affording only a small part of the information to be gained from a really good instrument.

The Richards Indicator contained many improvements on the instruments previously used. It was well adapted to engines running at the speeds commonly employed at that time; it was invented and was for years the standard indicator in both Europe and America. The weights of the many parts of this instrument are, however, so great that their inertia and momentum seriously affect the accuracy of the diagrams, and render it unfit for use under the conditions of high pressure and high speeds met with in ordinary practice at the present time.

FIG. 3.—10+22 A. M. Jan'y 3rd 1896, Scale 40.

Boiler Pressure 61



Some of the leading items of information to be obtained by the use of the indicator are: The arrangement of the valves for admission, cut-off, release, and compression of steam; the adequacy of the ports and passages for admission and exhaust, and when applied to the steam chest, the adequacy of the steam pipes; the suitability of the valve motion in point of rapidity at the right time; the quantity of power developed in the cylinder, and the quantity lost in various ways, by wire drawing, by back pressure, by premature release, by maladjustment of valves, leakage, etc. It is useful to designers of steam engines in showing the distribution of horizontal pressure at the crank pin through the momentum and inertia of the reciprocating parts, and the rotative effects around the path of the crank. Taken in combination with measurements of feed water, and the condensation and measurement of the exhaust steam with the amount of fuel used, the indicator furnishes many other items of information relative to the economical generation and use of steam.

The degree of excellence to which steam engines of the present time have attained is due more to the use of the indicator than to any other one thing, as a careful study of the indicator diagrams, taken under different conditions of load, pressure, etc., is the only means of becoming familiar with the action of steam in an engine, and of gaining a definite knowledge of the various changes of pressure that take place in the cylinder.

An indicator diagram is the result of two movements, viz: a horizontal movement of the paper—and consequently represents by its length the stroke of the engine on a reduced scale—and by its height at any point, the pressure on the piston at a corresponding point on the stroke.

The steam engine indicator has become an appendage to the steam

engine that has been entirely too little understood by the majority of men who follow the profession of steam engineering. Indeed it is not many years since the use of the indicator was considered to belong to a special profession or class of persons, styling themselves "experts," many of whom were not only entirely devoid of any cultivation with reference to the application of the indicator, but were decidedly deficient in their actual knowledge of steam, while some others were well qualified to give honest judgments as to what they found, what they saw, and to indicate, correct, adjust and advise without any sort of reference to their pocket interests. Many of these so-called

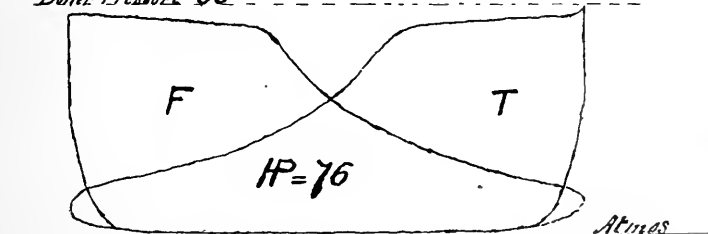
changes of pressure on the piston of the steam engine during both the forward and return stroke. The indicator was invented by James Watt and was extensively used by him in perfecting his engines. It was a somewhat crude affair as compared with the instruments of the present day, being in design very much like a walking beam engine, the cylinder and piston being at one end of the walking beam and the pencil, with paper drum, at the other.

Of the earlier forms of the indicator it may simply be said that they were unfit for use on an engine running at any but the slowest speeds; even then, owing to their many imperfections,

* Paper read before Kingston Association, No. 10, C.A.S.E.

FIG. 4. Trip Rods adjusted — 11+50 A. M. Jan'y 3rd 1896. Scale 40.

Boiler Pressure 65



"experts" persuaded themselves that the working engineer was only a man to shovel coal, or put on grease, oil or slush, as the case might be, and that the "expert" should be called in whenever anything existed that was not up to the mark. But the time for setting the valves of an engine by the eye, or by scratches, or centre punch marks, has, in the opinion of intelligent and competent engineers, passed away, and the engineer of the future will probably be a man who will be capable of a careful manipulation of the indicators, and of producing the highest economic results from following the lines drawn therefrom, without regard to the whims of builder, owner or others, being himself qualified to read the lines, and make them by the proper manipulation of the instrument.

WHEN AND HOW TO ATTACH THE INDICATOR.

There is always a clearance in every engine. This is the space between the piston at the extreme end of the stroke and the cylinder covers. There is quite a difference in the amount of clearance allowed by builders, but now all first-class builders have reduced the space to a minimum—as little as 5 to 8%—as this space has to be filled with steam twice during each stroke in a fast-running engine, it soon foams up to quite a sum of money in fuel: in fact, I know of one engine, the cylinders of which were 24" diam. and intended for 24" stroke, but it was found that the cranks, if they were 11" would not clear in the foundation plate, so they were made 10 1/4", making the stroke 21 1/2"; the pistons and covers were left as originally intended. As a consequence the owners became bankrupt. The vessel was sold to another company, who put in new boilers, ran her on a good paying route for a few years, then had the good fortune to convert the engines into a compound, when the fuel was reduced from 110 tons per week to 49 tons; of course the compound got the credit.

But this is a digression. The proper place to put the connections for indicator is in the clearance space, so that the pistons will not at any time even partially cover the hole. If there is not 1/2" clearance the hole should be drilled towards the cover and a groove cut in the cover to suit. To indicate an engine properly, so as to be able to give a correct report, it is necessary to know what is the total amount of clearance, including the ports. As this space has to be filled with a volume of steam twice during every revolution, if clearance is too great there will be great difference in the reading of the diagram. After the diagram has been traced by the instrument, it is necessary, when trying to get at the economic result, to erect the volume of clearance on the card. Some engines will take a beautiful card, but when the volume of clearance is added it looks very different. This often occurs in the marine walking beam engines with the Stevens cut-off.

In putting on the indicators it is best to have two instruments—one at each end of the cylinder—and have them both taken at once. The usual connections of a side pipe with a T or three-way valve in the middle, and taking both ends on the same card, may do very well for a short-stroke, slow-moving engine, but under any other conditions may be the source of error to a large extent, so it is much better practice to take the diagrams as already mentioned with two indicators simultaneously.

The next thing is a good reducing motion; one of the best is the Brumbo pulley; another good device is the Pantograph, which, if properly made and used, is scientifically correct. With the Brumbo pulley the line may be used at an angle, but with all other devices the line must run at true right angles. These conditions being complied with, you may put on your indicator and connect the cord so that the drum of the instrument works in the centre of motion; then warm up the indicators by turning on the steam, and after the water is all blown out, press the pencil lightly to the card, taking care to let the pencil go but once around the figure, then turn off steam and press the pencil again to the card and mark the atmospheric line, and your diagram is complete as far as the indicator can make it. The knowledge of the operator has now to be brought into use.

The British Columbia Light and Power Company has been organized and seeks authority from the provincial government to supply electric light and power to the towns of Trail and Rossland. Among the promoters are Messrs. W. S. Norman, of Rossland, and Wm. Archer, of New York. The syndicate have already spent \$100,000 in putting in turbine wheels, flumes, etc., in connection with placer mining on the Pend 'Oreille river, near Waneta, B. C., and have 3,000 horse power at their command. They wish to increase their capital to \$1,000,000, and to transmit 1,500 horse power over a distance of 17 miles to Rossland and Trail.

TRADE NOTES.

The contract for additional motors for the St. John Railway Company has been placed with Ahearn & Soper, of Ottawa. The equipments will be of the Westinghouse 12-A type.

The Packard Electric Co., Ltd., of St. Catharines, Ont., have notified their customers that their factory will be closed down during the first two weeks of April on account of unwatering of the Welland canal.

Pulp mills in New York, Massachusetts, Maine and New Hampshire are receiving large quantities of their raw material from Canada in the form of spruce logs. The middlemen who buy the wood from Canadian farmers and lumbermen and deliver them to the pulp mills on the other side of the line make a handsome profit. What is the matter with Canadians working their own pulp wood in their own country? The Robb Engineering Company, of Amherst, N. S., are now making a full line of pulp machinery.

The Northley Manufacturing Co., Toronto, the well known makers of steam pumps, have in course of construction a new building, to be used as a foundry. It is the intention of the company to in future make their own castings, and for this purpose the new building is being equipped with the latest type of cupola, tramways and cranes for the easy handling of iron and heavy castings, etc. A Robb-Armstrong engine has been purchased for the special purpose of operating the fans, which will supply the air blast to the cupola. The company have also about completed patterns for a 10 h. p. oil engine, and it is their intention to manufacture these engines in all required sizes.

A correspondent writes from Toronto Junction to the Toronto World as follows: The Dodge Pulley Company's works at Toronto Junction are running fifteen hours per day, with a full complement of men. The company tell us that never in the history of their eleven years' business in the Dominion have they been so crowded with work. The manufacture of their celebrated wood split pulley is constantly increasing. Recent large shipments have been made to Madras, India, and to agencies in Central America. While the order alone for over 1000 pulleys is at present being prepared for shipment for the English market. In addition to the manufacture of wood split pulleys, the Dodge Company are also general machinists and millwrights, and have now in work complete power transmission plants for several electric stations, including shafting, floor stands, friction clutch pulleys, bearings, heavy iron centre driving pulleys, etc. The Dodge Company are also doing a lot of special work for some of our largest mining plants. In the company's machine shop at present are sixteen friction clutches in work for contracts on hand.

It is stated that Mr. H. J. Beemer, who was instrumental in securing a charter for the Quebec electric street railway, will construct an electric railway between St. Joseph de Levis and Chaudiere, Que.

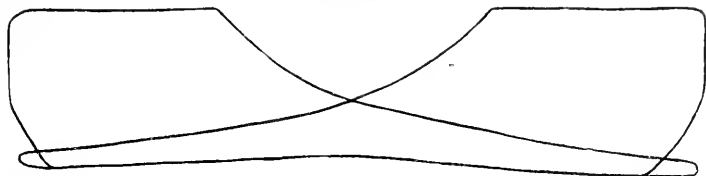
A bitter legal suit is likely to be the result of the competition for lighting patronage between the Ottawa Electric Co. and the Hull Electric Co. The Hull Electric Company has served the Ottawa Electric Company with notice of a claim for twenty thousand dollars damages for infringement upon the territory and rights of the Hull company in the city of Hull. In default of payment an action will be entered in the Superior court to recover the amount. The Hull Electric Co. claim that, according to a special act of the Quebec legislature, the exclusive privilege for supplying light for a period of 35 years from May, 1894, was granted to Mr. Viau. The Ottawa company, in addition to the payment of \$20,000, are requested to remove their poles, electric apparatus and appliances from the streets.

Representatives of the Canadian General Electric Company, Toronto and Peterboro, appeared before the Tariff Commissioners at Ottawa last month. They pointed out that they paid higher duties on their imported raw material, which constituted 75 per cent. of the finished machine, than the duty which is charged upon their finished article when imported, and consequently they had no protection. If there was a reduction of duty on the imported article, they desired a corresponding reduction on their raw material. The chief articles imported were steel castings, copper, charcoal, sheet iron, fine linen, certain varnishes, press board, parchment papers, silver tubing special tinned steel wire, German silver wire, music wire, all of which were not made in Canada.

PUMPING ENGINE TESTS AT PETROLEA, ONT.

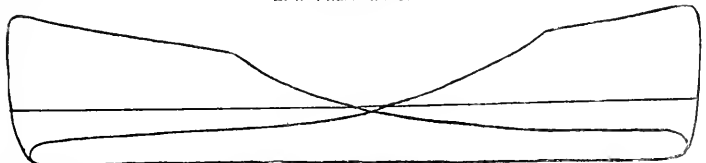
IN connection with the new waterworks system recently constructed for the town of Petrolea, Ont., under the direction of Mr. Willis Chipman, C. E., of Toronto, there have been installed two pumping engines—one a high duty—the other a medium duty

CARDS FROM HIGH PRESSURE CYLINDER OF HIGH DUTY ENGINE.
Scale 1/80.



Diameter of Cylinder, 13 inches. Stroke, 32 inches. Piston Rod, $2\frac{1}{4}$ inches. Pressure by Steam Gauge or Boiler, 125 lbs. Vacuum by Gauge, 25.3. Revolutions, 50 per minute. M. E. P., 51.5. I. H. P., 59.4.

LOW PRESSURE CARD.



Cards from Low Pressure Cylinder.

Cylinder, 26 inches by 32 inches. Piston Rod 2.5. Boiler Pressure, 124 lbs. Vacuum, 25 inches. Revolutions, 50 per minute. M. E. P., 14.2. I. H. P., 60.59. Temperature of Feed, 115. Scale of Card 1/32. Receiver Pressure, 32 lbs.

duplex. The contract for these engines was given to the Hughes Steam Pump Company, of Cleveland, who sub-let to the London (Ont.) Machine and Tool Works a contract for the construction of the high duty engine, in order that the whole contract might be completed within the specified time. The general specifications for these engines were drawn by Mr. Chipman, and gave the size of cylinders, plungers, valves and connecting pipes, and the general arrangement of the plant. Each engine was to have a capacity of 1,000,000 imperial gallons in 24 hours, against a head of 485 feet, and the specifications were so drawn that for each million ft. lbs. that the duty fell short of 100,000,000, the sum of one hundred dollars was to be deducted from the contract price. The duty was to be calculated from the amount of coal used, no deduction being made for ashes, and from feed water at 180°.

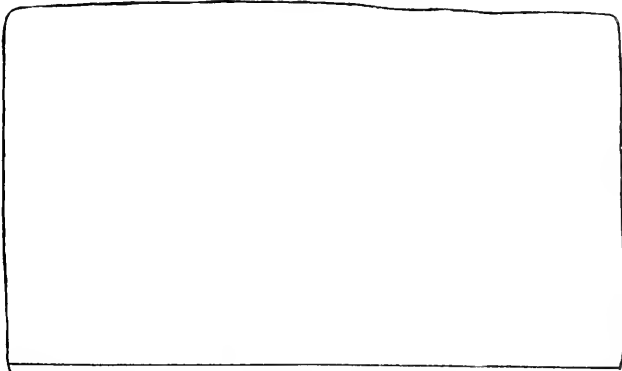
A ten hours test of the high duty engine was made on the 4th and 5th of February by Messrs. Willis Chipman, C. E., and J. H. Killey, of Hamilton, on behalf of the municipality and the manufacturers respectively.

There was considerable difference of opinion on the part of Mr. Chipman and Mr. Killey as to the result, the former placing the duty obtained at 95,000,000, and the latter at 103,798,200. It was agreed therefore, that a second test should be made, which was conducted by Mr. Chipman alone, in the presence of Mr. Yates, of the London Machine and Tool Works and Mr. Hughes,

of the Cleveland Company. The test, as in the former instance, occupied ten hours. The engine was run at 52 $\frac{3}{4}$ rev. per m.; water pressure, 200 lbs. to the sq. in.; steam pressure, 125 lbs. to the sq. inch; intermediate cylinders, 16 lbs. to sq. in.; vacuum 24; vertical distance from gauges to water in well, 14 feet; feed water used, 360 cubic feet at 110°; coal consumed, 2430 lbs.; ashes,

120 lbs.; temperature flue gases, 220°. As mentioned above the duty was calculated from the amount of coal used, with no deduction for ashes, and from feed water at 180°. The result was a duty of 98,500,000. This duty is stated by the gentlemen who conducted these tests to be considerably higher than that shown by any other pumping engines of similar size in Canada, and the engine and pumps are said to have worked well under nearly double the head of water of any waterworks engine in the Dominion, while the boilers are said to have steamed freely without forcing. The boilers are of the horizontal tubular type, set in brick work, externally fired. The gases of combustion pass under the shells and return through the tubes and through two up-takes through a horizontal pipe flue to the brick chimney outside of the building. The accompanying indicator cards, taken at the first test, show how perfect was the

CARD FROM PUMP CYLINDERS.



Diameter of Pump Plungers, $6\frac{1}{2}$. Stroke, 32 inches. Piston Rod, 2 inches. Revolutions, 50 per minute. Lift by Suction, 12 feet. Indicator connected with pump band by a short $\frac{1}{2}$ inch pipe having an angle; full way valve as well as indicator was wide open on test. Scale of card, 1/80. Area of Plunger, with one half the rod off, 31.61. The total lift not shown on steam gauge, including friction of suction pipe, pump, and valves, 20.5 feet.

action of the engine. The guaranteed capacity of the duplex engine was 50,000,000, and the result of the test gave a duty of 53,000,000.

Mr. Ross has introduced a bill in the Ontario legislature providing that a high school board may, by resolution, establish a technical school, and any high school already established may be changed into a technical school.

ELECTRIC RAILWAY DEPARTMENT.

DECISION RELATING TO SUNDAY CARS.

In the Court of Appeal at Toronto judgment was recently given in the case of the Attorney-General of Ontario vs. Hamilton Street Railway Company, dismissing the plaintiff's appeal against the decision of Judge Rose declaring the street railway company within its rights in running street cars on Sunday. The text of the judgment delivered by Chief Justice Burton is as follows:

This is an appeal from a judgment of Mr. Justice Rose holding that the defendant company, which own and operate a street railway in the city of Hamilton, do not come within the meaning of the words, "or other persons whatsoever," as found in the first section of what is generally known as the Lord's Day Act, originally passed in 1845, and entitled "An act to prevent the profanation of the Lord's day, commonly called Sunday," and now to be found in the revised statutes, cap. 202.

Unfortunately the decisions in England under the statute of 29, Charles the Second, for a similar purpose, afford us but little assistance in the construction of our own statute. Had the language of our statute followed precisely sec. 5 of the statute of Charles, this question would have been free from doubt, and the decision in Sandiman vs. Breach decided in England in 1827, and the reasoning of that judgment, which is in conformity with a long course of decisions, would show that the maxim of ejusdem generis would clearly apply.

Our legislature did not, however, adopt that section, but after adding "merchant" to the enumerated persons who are forbidden to do or exercise any worldly labor, business or work of their respective ordinary callings upon the Lord's day, makes this exception, (conveying travellers or Her Majesty's mail by land or water, selling drugs and medicines, and such other works of necessity only excepted.)

Now this exception was clearly unnecessary as regards the persons specifically enumerated. No one would expect the carrying of travellers or conveying Her Majesty's mail to fall within the ordinary work or calling of a merchant, tradesman, artificer, mechanic, workman or laborer, and counsel for the appellant therefore contended that a wider construction should be given to the words "or other persons whatsoever" than they should receive if they were found in connection with the specific persons named without other qualifications. There is much force in the contention, and I was at first inclined to think that in order to make the whole section consistent and intelligible the words should receive a wider construction and apply to all persons, including corporations, having an ordinary calling. I am satisfied, however, upon further consideration, that we cannot concur in such a conclusion without in effect overruling a line of decisions which have prevailed in the courts for over a century.

It must be borne in mind that the legislature must be presumed to have been aware of this line of decisions when they passed the 8th Vict., and if they then intended to embrace every description of persons and every species of business, in the ordinary calling of such persons, it would not have been necessary still to retain the specific enumeration of several classes of persons exercising particular descriptions of labor or business similar to those enumerated in the statute of Charles. It would have been sufficient to say in general terms that no person whatsoever should do any work or business in his ordinary calling on the Lord's day. But this is made more clear when we find that the legislature did decide to add to the enumerated classes merchants. Here again the object could have been attained by striking out the enumerated classes and extending the section to all persons, but when we find them adding "merchant" by that description to the other enumerated classes, followed by the words in question, it leads, I think, to the irresistible conclusion that a merchant would not be included in the words "or any other persons whatsoever," but that those words must, according to the general rule, that preceding particular words, control subsequent general words, be construed to mean persons ejusdem generis with those already mentioned, all of whom exercised an ordinary calling, and that if a carrier, and perhaps a fortiori a corporation, carrying on a business of a carrier of passengers, were intended to be included in the prohibition, they would have been specially mentioned in the same way as a merchant has been mentioned.

It is not within our province to determine the wisdom or expediency of the law, and although it may in the opinion of many persons be considered desirable that other secular concerns besides those expressly mentioned in the statute should be comprehended in it, we must be careful not to extend the words of the statute beyond their natural import; to do so would be to legislate and not to interpret the law as we find it.

It may be that the legislature may consider it desirable that all persons doing an ordinary calling shall not do any labor, business or work at that ordinary calling on Sunday; if so, it is easy for them so to declare. But this a penal enactment, and any infraction of it subjects the party infringing it to a penalty. We ought not therefore to hold any party within the first section unless it is clear to our minds beyond any reasonable doubt that he is intended to be included. But the Act contains internal evidence that was not intended to include corporations, for in the 14th section, dealing with penalties, it is provided that the party offending may, by default of payment of the fine imposed, be

committed to the common jail for any term not exceeding three months, and the form of conviction in the schedule to the Act is to the same effect.

I think it impossible therefore to hold that the learned judge was wrong when he held that the defendants were not within the words "other persons whatsoever."

This renders it unnecessary to decide the meaning of the word "travellers," as found in this Act. I think it worse than useless to refer to the interpretation of the word as found in the decisions in England under the Ale House Acts. Those acts were passed "alio inter," and can afford us no assistance in arriving at the meaning to be attributed to the word under our statute.

I think finding the word in connection with the carrying the royal mail and described as inter alia, a work of necessity, there ought to be no difficulty in ascertaining what was intended. I agree with so much of the judgment pronounced so many years ago by Sir John Robinson, delivering the decision of the Court or Queen's Bench, as defines the work travellers as used in the Act, and I think it sound law to-day as it was then.

Opinions may differ as to these statutes, some being of opinion that the statute of Charles is wholly unsuited to the present age, whilst others are of opinion that our act is "a useful and salutary enactment." But we cannot overlook the fact that in the time of Charles travelling upon Sunday was illegal, so that there could be no recovery from any injury sustained in the course of the journey. And although our act is not so stringent in its provisions, still its promoters had in view the prevention of what they deemed as profanation of the Lord's day, and excepted only such conveying of travellers as came within the meaning of a work of necessity.

How any one could hold that excursionists either to the Island or anywhere else came within the definition of "travellers" within the meaning of the framers of our own act (to use the very expressive but not perhaps very judicial language of Lord Bramwell) "beats me."

It was said in the case in which that was so held that Regina vs. Tinning was decided before the subsequent cases which are referred to in that judgment.

The application of cases decided under the English Ale House Acts to an act of this nature is most misleading, but none of them in the slightest degree conflict with the judgment of Sir John Robinson in Regina vs. Tinning, and obviously have no bearing in construing the exception of what is regarded as a work of necessity in the present Act, passed for the purpose of preventing what in the opinion of its framers was regarded as a desecration of the Sabbath. I am of opinion, therefore, that the appeal should be dismissed and the judgment below approved.

The court was unanimous.

Mr. Justice Osler concurred in the judgment of the Acting Chief Justice, but said that he did not desire to give any opinion as to the meaning of the words "conveying travellers." Mr. Justice MacLennan also concurred, but based his judgment entirely upon the ground that the Lord's Day Act was not intended to include and could not be made applicable to any corporation.

SPARKS.

A company will, it is said, undertake the construction of an electric railway between St. Johns, Longueuil and St. Lambert, Que.

The Hamilton Radial Railway Company propose to extend its Beach line to the easterly limits of Burlington, and establish there a park and pleasure grounds.

The Hamilton, Chedoke and Ancaster Electric Railway Company will shortly let the contract for the construction of their road from the corner of Herkimer and Hess streets to Chedoke.

The Kingston Street Railway Co. will make several improvements to their line, including its extension to the depot. New motors will be secured for the cars running to Portsmouth, to provide a faster service.

The Railway Committee of the Ontario legislature have passed the bill to incorporate the Ingersoll Radial Railway Company, which proposes to construct electric roads to St. Marys, Tilsonburg, Brownsville, etc.

The Railway Committee of the Ontario parliament have passed the act incorporating the Lanark County Electric Railway Company, to construct a railway from Perth to Lanark, with branches. The promoters are: Alex. H. Edwards, Carleton Place; John B. Riley, Plattsburg, N. Y.; Thomas Henry, Montreal; James Fowler, Arnprior; George A. Fowler and J. A. Houston, Ottawa.

McKain vs. Ottawa Electric Railway Co. is a suit brought by the former, a property owner on Cedar street, claiming that as the result of the change in the grade of the street made by the Ottawa Electric Company, his property has been depreciated in value to the extent of \$1,500. The company claim, on the other hand, that any damage sustained in that way is counterbalanced by the proximity of a line of street railway, and also, having authority from the corporation of Hintonburg to use the street, they were not directly responsible. A decision has not yet been given.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL.

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No. 5.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.



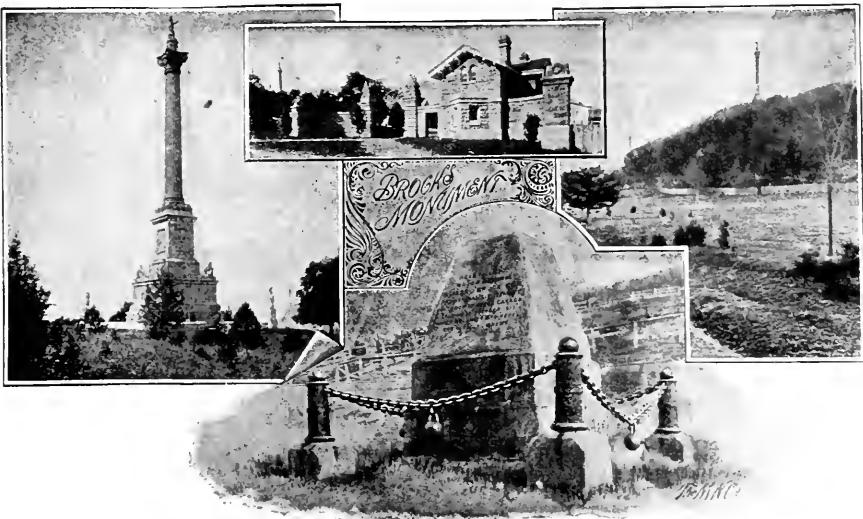
ARRANGEMENTS for the approaching Convention of the Canadian Electrical Association at Niagara Falls, Ont., are so far completed that we are able to present on this page a copy of the programme which has been arranged for the occasion. A

brief study of the programme will suffice to show that the coming convention is likely, from every point

LIST OF PAPERS.

- "Day Loads for Central Stations and How to Increase Them." J. A. Kammerer, Toronto.
- "Submarine Cables. Dealing more especially with the Actual Experience in Cable-Laying and Maintenance in this Country." D. H. Keeley, Ottawa.
- "Determination of the Heating Power and Steam Producing Value of Coal from a Preliminary Examination." Wm. Thompson, Montreal.
- "Water-Driven Plants." John Murphy, Ottawa.
- "The Commercial Aspect of Electric Railways." C. E. A. Carr, London, Ont.
- "Accumulators: Their Application to Central Station Lighting and Power." W. A. Johnson, Toronto.
- "Why Some Lighting Plants do not Pay." F. C. Armstrong, Toronto.
- "Steam End of an Electric Plant." A. M. Wickens, Toronto.

NOTE.—It is proposed to introduce at this Convention a Question Drawer. Members are invited to forward questions to the Secretary prior to May 2nd, and an effort will be made to furnish satisfactory answers at the Convention.



VIEWS AT QUEENSTON HEIGHTS.

of view, to be one of the most interesting in the history of the organization, if indeed it does not surpass any that has preceded it.

CONVENTION HALL—DUFFERIN CAFE, QUEEN VICTORIA PARK, NIAGARA FALLS, ONT.

BUSINESS PROGRAMME.

WEDNESDAY, JUNE 2ND.

- 7.00 P.M. Opening of first session in Convention Hall, Dufferin Cafe, Queen Victoria Park.
- President's Address.
- Reading Minutes of last Meeting.
- Secretary-Treasurer's Report.
- Reports of Committees.
- General Business.
- Presentation of Papers.
- Discussion.

THURSDAY, JUNE 3RD.

- 9.00 A.M. Consideration of Reports of Committees.
- Election of Standing Committees.
- Selection of Place and Time of next Meeting.
- Election of Officers and Executive Committee.
- General Business.
- Presentation of Papers.
- Discussion.

SOCIAL FEATURES.

WEDNESDAY, JUNE 2ND.

- 7.00 p.m.—By special invitation of the management of the Buffalo and Niagara Falls Electric Railway Co., an Excursion by special electric cars from Niagara Falls, N.Y., to Buffalo. Visit of inspection to Buffalo Railway Power House. Returning, reach Niagara Falls about 11 p.m. By courtesy of the Suspension Bridge Co., members taking part in this Excursion will be permitted to cross the Suspension Bridge in both directions without charge.

THURSDAY, JUNE 3RD.

- 8.00 p.m.—Annual Banquet at Dufferin Cafe.

FRIDAY, JUNE 4TH.

- By courtesy of the undermentioned companies, the following programme has been arranged:—
- 9.00 a.m.—Special car will leave Hotel Lafayette for a trip over the Niagara Falls Park and River Railway to Queenston.
- 9.45 a.m.—Cross Niagara River by Niagara Navigation Company's Steamer to Lewiston, N. Y.
- 10.00 a.m.—Leave Lewiston by special cars on the celebrated Gouge Electric Railway, reaching Niagara Falls at 10.45.
- 11.00 a.m.—Visit of inspection to Hydraulic Power House.
- 11.30 a.m.—Descend by Incline Railway and take steamer "Maid of the Mist" for a trip to the foot of the Cataract, landing on Canadian side.
- 1.30 p.m.—Cross Suspension Bridge.
- 2.00 p.m.—Inspection of the Power House and Works of the Cataract Construction Co.
- 3.00 p.m.—Visits to various Electro Chemical Works.

STAMBOAT AND HOTEL ARRANGEMENTS.

The Association are indebted to the Management of the Niagara Falls Park and River Railway Co., and the Niagara Falls and Suspension Bridge Railway Co., for having kindly tendered the freedom of their respective roads to the members of the Association during the Convention.

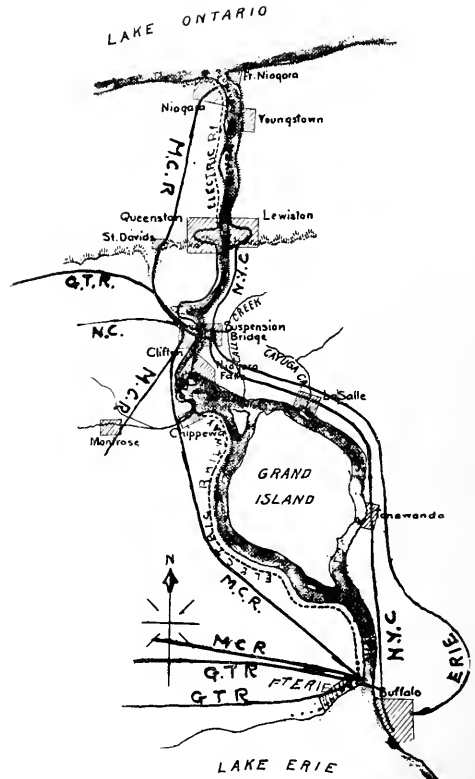
The Niagara Navigation Co. offer a reduced rate of \$1.25 from Toronto to Niagara and return to members and their friends on presentation of certificates signed by the Secretary.

The Hotel Lafayette, situated opposite the Upper Suspension Bridge, offers a special rate of \$5.00 per day to members and friends of the Association in attendance on the Convention.

A great transformation has taken place in the vicinity of Niagara Falls in recent years, and persons who may not have visited the locality will find much that is new, interesting and instructive. For the benefit of those who may not be familiar with the locality, especially since these changes were effected, we present in the accompanying views some of the points of greatest interest, but, as will be seen by reference to the programme, there are many others on both sides of the river, which will be visited, and which are calculated to please and instruct the beholder.

In accordance with a suggestion made by Lord Dufferin the legislatures of the State of New York and the Province of Ontario, acting in concert, upwards of ten years ago took steps towards securing control of a sufficient quantity of land on both sides of the Falls for the free use of the public, where they would be protected from the annoyances and exorbitant charges to which they had hitherto been subjected. Under an act passed by the Ontario legislature in 1885 the Lieutenant-Governor was authorized to appoint a Board of Commissioners, whose duties were to select such lands as might be required for the above purpose. The Commissioners so appointed had surveys made, and recommended the purchase of the territory extending from the Clifton House southwards following the general direction of the river, and back therefrom a distance of about 300 yards to near the top of a wooded escarpment. The total area of these lands is 154 acres, including Cedar Islands, the Dufferin group of islands and the talus under the cliff from the Clifton House southwards to the margin of the Horse Shoe Fall. These lands were afterwards purchased by the government of Ontario by arbitration, at a cost of \$436,813.24, and now comprise the Queen Victoria Niagara Falls Park, the management of which is vested in the Board of Park Commissioners. Subsequently the Dominion government transferred all its rights in these lands to the Commissioner. Since the purchase by government of the lands comprising the Queen Victoria Park, a large amount of skilled attention, as well as expenditure of money has been devoted to the beautifying of the park grounds. It will be remembered that towards this object the

ment of operations by the company on the first of the present month, in fulfilment of the terms of their agreement. Visitors to the convention will have the opportunity of viewing these operations, and of learning the plan on which the company propose to utilize and



ROUTE OF THE NIAGARA FALLS PARK & RIVER RAILWAY.

transmit power from the Falls to manufactories in the immediate locality and eventually to distant points.

The company's agreement provides that they shall have completed by 1st November, 1898, water connections for the development of 25,000 h. p., and have actually ready for use 10,000 developed h. p. of electric or pneumatic power. After the visitors to the convention shall have seen the herculean task which has been accomplished on the American side of the river by the Cataract Construction Co., with which the Canadian company is closely identified, they will not be disposed to doubt the certainty of the successful completion of the Canadian undertaking.

Closely skirting the Canadian side of the river from Chippewa to Queenston runs the Niagara Falls Park and River Railway. A plan of the route, together with an illustration of the power house above the Falls, accompany this article. From the cars on this road the visitor is given a complete view of the river throughout those parts which are visited by the tourist. The road, which was completed in 1893, connects at Queenston with the Niagara Navigation Company's steamers from Toronto. The trip over this road from Queenston to the Falls is one of the most delightful to be found in the world. As will be seen by the programme, the freedom of the road, which is under the able management of Mr. Wilfred Phillips, has been generously tendered to members and friends of the Association while in attendance on the convention.



THE HOTEL LAFAYETTE, NIAGARA FALLS, ONT.

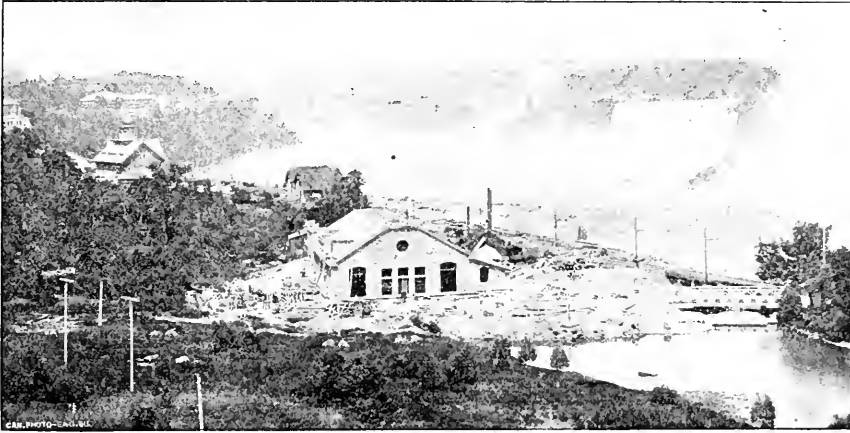
annual payment of \$25,000 by the Niagara Falls Power Co. has for a number of years past been devoted.

In this connection additional interest has been given to the coming convention by the recent refusal of the Ontario government to extend the time within which the power company might begin the construction of works for the utilization of the power of the cataract on the Canadian side of the river, and actual commence-

On the American side of the river the visitors are invited to witness many highly interesting and instructive sights, including a trip over the gorge railway, which, as stated in a previous issue, is built on the face of the cliff down near the edge of the seething current—as well as visits of inspection to various electric, hydraulic and chemical works clustered about the American

the annual Banquet, the success of which is assured, the above brief outline should suffice to show the attractive character of the arrangements which have been made for the entertainment and instruction of those who may attend this Convention.

Viewing the programme from a scientific and commercial point of view, it will be found to be not less



UPPER POWER HOUSE, NIAGARA FALLS PARK AND RIVER RAILWAY.



DUFFERIN ISLANDS FROM ABOVE WYNN'S.

Falls, and of which the gigantic works and equipment of the Cataract Construction Co. forms a fitting center.

The excursion to Buffalo and the inspection of the power house there, in which the current generated at Niagara Falls is received, transformed and put to commercial use, will certainly not be the least pleasant and instructive feature of the occasion.

Without entering into further details, such as are given in the programme, beyond a special reference to

satisfactory. The papers are of a highly interesting and instructive character, and should evoke valuable discussion.

Realizing that the Association should be made as helpful as possible to the electrical industries of the country, the Executive have recently issued a letter to electric lighting companies throughout the country, asking their attendance at this Convention in order that proper consideration may be given to ways and means

whereby the interests of private lighting companies may be saved from annihilation at the hands of the municipalities. As was pointed out in our last issue, this is a subject which should engage the immediate attention of all persons who have capital invested in electric lighting machinery. In the Canadian Electrical Association there exists ready to hand an organization which can be made use of to further this object. We therefore hope and expect to see the electric lighting interest largely represented at this Convention, and action taken which will prevent the wiping out of the large amount of private capital which has in good faith been invested in the electric lighting business.

AUTHORS OF C. E. A. CONVENTION PAPERS.

THAT our readers and members of the Canadian Electrical Association may become acquainted with the gentlemen who have consented to read papers at the forthcoming convention at Niagara Falls, we present the accompanying portraits and brief biographical sketches. One or two photos had not come to hand at time of going to press, consequently the omission.



MR. JOHN MURPHY,
Superintendent of Power Houses, Ottawa Electric Company.

Mr. Murphy was born in Ottawa and educated at the common schools. During a term at Ottawa University he acquired a taste for electrical work, and entered into employment with the Bell Telephone Company in 1884. He has been continuously engaged in various branches of electric light and power work since that time, and during the past three years has occupied the position of superintendent of power houses for the Ottawa Electric Company.



MR. F. C. ARMSTRONG,
Chief Sales Agent Canadian General Electric Company.

For a number of years Mr. Armstrong has been connected with the Canadian General Electric Company, of late years as chief sales agent. He is well-known in electrical circles, and has taken an active interest in the work of the Canadian Electrical Association, having served as a member of the Executive Committee, as well as contributed papers on different subjects at past conventions.

MR. J. A. KAMMERER,
Chief Sales Agent Royal Electric Company.

Born at Suspension Bridge, N. Y., Mr. Kammerer was educated at the public and private schools at that place. Up to the year 1880 he was engaged in different branches of railway work, and for the following eleven years in train dispatching in the United States and Canada. Since April, 1891, he has been connected with the Royal Electric Company, of Montreal, and now occupies the position of chief sales agent, with head office at Toronto. We regret that we are unable to publish portrait herewith.



MR. W. A. JOHNSON.

Mr. Johnson has been connected with electrical matters and manufacturing for 22 years, for the last 15 years having made a specialty of dynamos, arc lamps, accumulators, etc. Previous to 1894 he was general manager of the Ball Electric Light Co. (the pioneer manufacturing company of Canada), he having successively acted for said company as mechanical superintendent, secretary and engineer. Early in 1894, after disposing of his interest in the Ball Company, Mr. Johnson started a manufacturing and contracting business under the style of W. A. Johnson Electric Company, and has built up a large and increasing trade. His long practical experience has secured to his firm the Canadian representation of several well-known American firms, such as the Electric Storage Battery Co., the Walker Railway apparatus, the Wagner transformer, the Manhattan and Puritan arc lamp, etc.



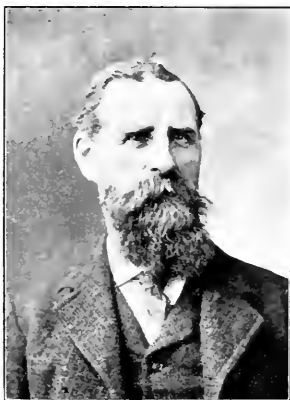
MR. WILLIAM THOMPSON,
Superintendent Waterworks and Electric Light Plant, Montreal West, Que.

Mr. Thompson was born in Middlesbro, Eng., the home of the iron trade, and came to Canada in 1883, finding employment in Toronto and Brampton.

Since 1891 he has been employed by Armstrong & Cook, as superintendent and chief engineer, operating

their waterworks and electric light plant at Montreal West, Que. Both the electric and waterworks systems were installed under his supervision.

To thoroughly equip himself and master all the details of his profession, Mr. Thompson has taken a special course in analytical chemistry under the tuition of the well-known chemist, Prof. J. T. Donald, of Bishop's University, Montreal.



MR. A. M. WICKENS,

Electrician and Engineer for the Ontario Government.

Mr. Wickens served his apprenticeship as a machinist at the works of the Watrous Engine Works Company, Brantford, leaving there at the expiration of his term for the western states. Returning to Canada in 1874, he was employed as erecting engineer for the Worswick Engine Co., of Guelph, until 1885, at which time he moved to Toronto, taking the situation of engineer at the Globe office. This was when the first incandescent lights were installed in Toronto. When the Globe office was moved to the new building at the corner of Yonge and Melinda streets, a change was made from a shafting and belt transmission to an electric drive and transmission of power, this equipment being the first of its kind in Canada, and consisting of a motor for each machine, making a total of 14 motors for 58 or 60 h.p. These were the first motors in use in the city of Toronto. Shortly after this plant was installed Mr. Wickens accepted his present position as engineer and electrician for the Ontario government.



MR. C. E. A. CARR,

Manager London Street Railway Company.

Mr. Carr was born at Barrie, Ont., and at the age of sixteen years removed to Toronto, where he took a three years' course in a commercial college. He was afterwards employed for three years in the office of Mr. W. T. Jennings, then city engineer of Toronto, during

which time the street railway was transferred from the Frank Smith Company to the city, and afterwards to the present company. In this connection Mr. Carr became familiarly associated with street railway matters. Early in the year 1893 he accepted the position of private secretary to Mr. H. A. Everett, manager of the Toronto Railway Company, and shortly afterwards the greater portion of the system was converted into an electric road, which afforded Mr. Carr much practical experience in the equipment and operation of an electric railway. His appointment as manager and treasurer of the London Street Railway Company was made on February 11, 1895, since which time the road has been changed to an electric system.

MR. D. H. KEELEY,

Superintendent Government Telegraph Service.

Mr. Keeley has long been prominently connected with telegraph work, having for a number of years been employed as assistant to the late Mr. F. N. Gisborne, who was superintendent of government telegraphs from the beginning of the service until his death in the year 1892. Since that time Mr. Keeley has had entire charge of this service, executing his duties in a manner which is said to be highly satisfactory to the department. His wide and varied experience, as may be estimated from the fact that the government telegraph service now includes 2,451 miles of land lines and 206 miles of submarine cables, assures an interesting paper at the approaching convention.

A BIT OF TELEPHONE HISTORY.

At the annual dinner of the National Telephone Company of Great Britain, held in London the other day, Mr. W. H. Preece, in responding to a toast on "Telephony," gave an interesting bit of history anent the early days of the telephone. "Exactly 20 years ago," said he, "the postmaster general of that day commissioned Mr. Fischer and myself to proceed to America for the purpose of inquiring into the invention of a curious instrument that transmitted the voice from one end of the land to the other." He went determined to expose the fraud, but had not been in company of Graham Bell five minutes before he became an ardent believer, and ever since then the apostle of the telephone. Comparing the receiver of to-day with what he brought from the States 20 years ago, there was not very much difference. In extending the use of the telephone in England they had to encourage mutual assistance between the suppliers and the subscribers. The system was growing very rapidly in England, and although the trunk wires had fallen into the hands of the post-office, there were more trunk wires being operated in Great Britain than in the whole of Europe.

A good artificial water cement is obtained by heating for some hours to redness a mixture of 3 parts of clay and 1 part of slaked lime by measure.

The Consolidated Railway Company's system in Victoria, Vancouver and New Westminster, has passed into the hands of an English syndicate, to be known as the British Columbia Electric Railways Company, Limited.

Mr. A. J. Coriveau, who was one of the promoters of the Montreal Park and Island Railway, is now forward with a scheme to construct a network of trolleys through the eastern townships of Quebec, connecting Montreal and the south shore with St. Johns and other leading towns. The line as proposed would be one hundred and fifty miles in length, and would pass through Chambly, St. Johns, Bedford, Cowansville, St. Hyacinthe, Sweetburg, Knowlton, Magog and Sherbrooke. The power is to be obtained from the Chambly Water Power Company, and the cars are to be run forty miles an hour. The capital required, which is to be provided by Canadians, Americans and Parisians, is placed at \$2,000,000.

An engineer gives an account of a method of removing and replacing a broken foundation bolt for an engine as follows: A 3-inch bolt was broken off below the capstone, about 40 inches from the top nut. The upper piece was removed and a one inch ratchet bit inserted through its 4-inch pipe case and a short vertical hole drilled in the top of the broken piece and threaded to receive a left-hand eye bolt, by which the bolt was unscrewed from lower nut (that was fortunately set in a pocket of the bearing casting) and lifted out of the hole, a piece welded on threaded, provided with a right-handed stud eye in the top to handle it and screw it into the bottom nut again, and it was successfully replaced and the connection with the bed plate restored.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE. Secretaries of Associations are requested to forward matter for publication, this Department not later than the 25th of each month.

BROCKVILLE NO. 15.

J. Aikens, secretary of the above association, writes: "At our last regular meeting we had the pleasure of initiating two new members, and several others are making enquiries about joining. Bro. John Grundy suggested the plan of having junior and senior classes in our educational department, as some members could not work out the more advanced rules. The idea proved to be a good one, and much appreciated by the members. Brother Grundy is junior teacher and past president; Bro. Chapman senior teacher.

ANNUAL BANQUET OF HAMILTON NO. 2.

A large number of engineers and their friends gathered at the Commercial Hotel, Hamilton, on the evening of the 15th ultimo, the occasion being the annual banquet of Hamilton No. 2, C.A.S.E. Mr. R. Mackie performed the duties of chairman in his usually happy manner. Among those present were Ald. Findlay, Donald and McLeod; Messrs. Geo. Black, manager G. N. W. Telegraph Co.; W. H. Ballard, Inspector of Public Schools, and Mr. Gill, B.A., of the Collegiate Institute. A first-class supper was served by Mr. Maxey, and was followed by the toast list, "The

grew; "Manufacturers," Mr. Rodgers; "Sister Associations," Messrs. Walter Hossie, Toronto, and J. Geary, Guelph; "The Learned Professions," Messrs. George Black, W. H. Ballard and Mr. Gill; "The Press," Mr. J. H. Mattie, of the Globe, and the Host and Hostess, Mr. Maxey. The musical programme consisted of solos by Messrs. W. S. Hyslop, M. Wilson, W. Hood, Rod Hariss and W. S. Wilson, and duets by Messrs. Hyslop and Wilson, Mr. T. Blain playing the accompaniments. The committee in charge of the

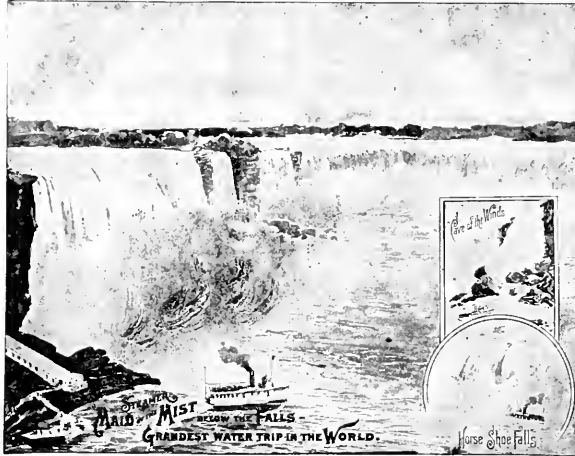
banquet was composed of Messrs. R. Mackie, chairman, J. Ironsides, secretary, W. Norris, W. Stevens, J. Johnston and W. Cornish.

THE ENGINEERS' ACT.

The committee appointed by the Canadian and Ontario Associations of Stationary Engineers to look after the proposed license bill to be presented to the Dominion government expect to go to Ottawa early this month. The bill will likely be considered by the committee within the next two weeks, and Messrs. A. M. Wickens, Arthur Ames and James Devlin will be present to explain its objects. It is the desire of the stationary engineers to be placed on the same footing as the marine engineers, and it is hoped that this will finally be accomplished.

The Bedford Electric Company will shortly erect a power house at Halifax, N. S.

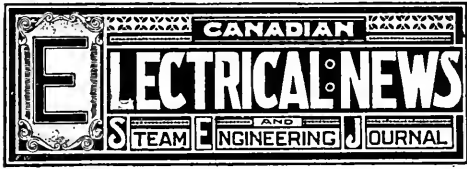
Mr. J. G. Lawson, for several years past foreman engineer on



"MOWAT GATE," AT ENTRANCE TO QUEEN VICTORIA PARK, NIAGARA FALLS, ONT., SHOWING N. F. P. & R. R. IN THE DISTANCE.

Queen" and "Governor-General" being duly honored by singing "God Save the Queen" and "The Maple Leaf Forever." The various toasts were responded to as follows: "Dominion Parliament and Local Legislation," Mr. James McGlanchlin; "Our Army and Navy," Mr. T. Carter; "The Mayor and Corporation," Ald. Findlay, Donald and McLeod; "Executive Head," Messrs. A. M. Wickens, W. Blackgrove and R. Petti-

the construction staff of the Canadian General Electric Company, has severed his connection with that company and gone to England to join Mr. W. Rutherford, formerly chief engineer of the Canadian General Electric Company and now manager of the electric traction department of the English firm of Dick, Kerr & Co. Mr. Lawson's departure is much regretted, not only by the members of the C. G. Company's staff, but also by the electrical public generally in Canada who have had an opportunity, through personal contact, of appreciating his thorough knowledge of practical electric-technics and his estimable personal character.



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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THE attention of our readers is directed A New Department. to the "Educational Department" which appears for the first time in this number. This department has been established in the interest and for the benefit of students of electricity and steam engineering who may be desirous of qualifying themselves to fill positions of responsibility in the future. The first of a series of articles by Mr. Wm. Thompson, of Montreal, written with this object in view, appears in the new department in the present number. Much of the information which will appear from month to month in these articles will be adapted to the requirements of engineers who may wish to qualify themselves to pass the examinations of the Ontario Association of Stationary Engineers. These articles will well repay perusal by persons desirous of gaining a clear and thorough knowledge of the foundation principles of mathematics, and of electricity and steam engineering, for the proper understanding of which a knowledge of mathematics is essential. In anticipation of large additions to the number of our subscribers, several hundred copies of the issues of THE NEWS containing the first of this series of articles, will be preserved. Our readers will confer a favor by making as widely known as possible the fact of the publication of these articles.

Value of Mechanical Stokers.

THE American Steam Users' Association recently sent out enquiries designed to draw forth information as to the value of mechanical stokers. The questions asked were: "Do Stokers Save Coal over Hand Firing?" "Do Stokers Save Labor over Hand Firing?" "Do Stokers Save Smoke over Hand Firing?" In answer to the first question, one report showed a loss, five no saving, and six a saving. To the second question one

answer showed an increased cost for labor, three no saving, and eight a saving. To the third question replies from two soft coal plants were in the negative, and seven in the affirmative. None of those who sent in replies would undertake to state that a net gain had been effected by the use of the stoker. We would be pleased to print the views of any of our readers who may have had experience with apparatus of this character, or with any kind of apparatus by the use of which it is claimed to be possible to effect a saving in fuel while maintaining the efficiency of the steam plant. The coal pile is the direction in which every owner and operator of a steam plant should turn his attention in these days of enforced economies. In times past, when the principles of combustion and of steam generating appliances were less perfectly understood than to-day, many a fortune went up the chimney in the form of smoke. And notwithstanding the advancement that has taken place in engineering knowledge, the waste of fuel is still enormous.

Transformers.

TRANSFORMERS are frequently regarded as a very simple piece of apparatus, that need not be taken any further notice of once they are securely put up on their pole and connected into the lines. And yet the more they are studied the more features they present worthy of careful attention. We have referred before to the advantage of selecting transformers less on the basis of price than on that of efficiency, and we would draw attention to some of the effects of the "drop" as seriously affecting the service. It is becoming more and more usual to use transformers "banked" on secondary mains, so that more equal distribution of potential may be attained, and to economize in the matter of transformers. Now if different makes, or even different sizes of the same make be employed, it is extremely probable that they will have different "drops," so that if they be all connected to the same secondaries, it is evident that those that have the smallest drops will take more than their due share of the load. This condition may exist to such an extent that a very few low-drop transformers may have to take the whole load of a circuit, in which case the least unfavorable result will be the diminution of the voltage on the lamps, and may possibly even cause fuses to go on the transformers; or if overfused they may burn out. That this is not a visionary result, the possibility of which exists only in the mind of a pure theorist, is evidenced by the recent trouble on a system in western Ontario, which was traced to this cause.

Process of Restoring Belting.

THE Electro Zeitschrift describes a new process of restoring worn out belting which has recently been brought out by Max Krieger & Co., Berlin, and which consists essentially in imbedding the belting, after it has been thoroughly cleaned, in a special composition and subjecting it therein to a moderate heat. This composition, which contains a number of different silicates, serves two purposes, namely, to add fat to belts which have lost their pliability, and abstract it from those which already have too much. The fat seems to flow from the belt to the composition, or vice versa, till a kind of equilibrium is established. The effect of the silicate composition can be increased by raising the temperature, so that by this means old resined belts can be re-

stored to their original pliability, and made available for use for a considerable time longer. A second advantage of this moistening of the leather consists in this, that stretched belts under this treatment return to their original length. If a belt, therefore, is first saturated with fat and then deprived of it by this process, it becomes more dense and lasts longer. It acquires an extraordinary power of resisting subsequent stretching. Belts that have been treated in this way work very uniformly for a long time, and require very little lubricating. The use of resin, etc., for increasing friction becomes altogether unnecessary. The power of absorbing lubricants is very much reduced, so that the belts will run a long time before they require to be treated again. The inventors assert that the life of a belt is doubled by this process, an assertion which, if verified, ought to lead to its being extensively adopted.

Central Station Management.

ELECTRIC lighting companies and consumers alike, are interested in the matter of rates, and this is a matter to which a great deal of attention is being paid by the more enterprising class of managers. In order to popularize electric light, it is necessary to give good light, and to supply it at a very reasonable cost. More especially is this so in places where consumers are under the necessity of exercising economy, and where, in consequence, the relative value of coal oil is higher than in towns where business is larger and more remunerative. As a general rule, not sufficient attention is paid to offering inducements to the more remunerative class of consumer, while such poor business as that afforded by churches, lodges, rinks, &c., is eagerly sought for. A church, contracting for 100 lights, must have that capacity always kept for it by the central station, which therefore cannot obtain for that 100 light capacity as high figures as it does for 100 light capacity rented for commercial or residential purposes, because churches and halls usually obtain considerably reduced rates. It is not safe to assume that the churches will be lighted only on nights when stores, &c., are not, because there are evening services on week days and festivals, when their load is on at the same time as the ordinary commercial load. It is therefore only just that such places should pay for their lighting a proportionately higher rate. The lighting period should be divided into parts, representing period of heavy load, of half load and of light load; and inducements should be offered to consumers to arrange for such consumption as they require to be at light load periods as much as possible. A little reflection will indicate to thoughtful, enterprising managers many ways of increasing their income without proportionately increasing their expenses.

State Regulation of Companies.

THE extent to which socialistic ideas prevail in these modern times is forcibly illustrated by the recent enactment of the Indiana State Legislature reducing street car fares in Indianapolis from five to three cents. It seems a monstrous thing that companies who have interested large amounts of capital in an enterprise designed to serve the public convenience, should be obliged to charge for their service whatever price the legislature may determine. No objection is raised to the right of the municipal and state governing bodies to regulate within reasonable limits the charges of com-

panies operating under public franchises, but it is manifestly unjust that these bodies should have the power to absolutely fix a maximum price for the service rendered by such companies. In nine cases out of ten governing bodies lack the requisite information regarding cost of plant and operation of such companies to enable them to determine what the charge for service should be in order that the company may realize something upon its invested capital and the labor devoted to the conduct of the enterprise. The public are too prone to regard companies as proper objects for assault in any and every form. The suspicion that a company is making a few dollars as the result of its enterprise, is sufficient to arouse public jealousy and opposition. If this condition of affairs continues to develop it will be the means of checking enterprise and improvement to a very deplorable degree. The decision of the Courts as to the legality of the Indiana Statute above referred to will be awaited with interest. It is extremely doubtful whether under the most favorable circumstances a street railway company can pay its way on a three cent fare,

versation by telephone in all parts of America, the Japanese use words corresponding in meaning to "You! You!" The opening of the first telephone line in Japan was made the occasion of a public holiday, and it is recorded that thousands of the natives took up a position along the line for the purpose of seeing the first message travel along the wire.

x x x x

I LEARN that you propose to publish, before the thermometer takes another rise, and the recollection of the recently vanished coal pile passes out of mind, some particulars and illustrations of electric heating appliances, and the uses to which they are adapted. In next issue I may feel called upon to dilate upon the heat dispelling qualities of the electric fan. It is thus that in the endeavor to be up-to-date we must suddenly switch out of one set of conditions into another.

ELECTRIC HEATING AND COOKING APPLIANCES.

THE Canadian General Electric Company are now



ELECTRIC HEATING AND COOKING APPLIANCES.

especially in view of the fact that the traffic is constantly being reduced by the use of the bicycle. If we mistake not, one or two American street railway companies voluntarily gave the three cent fare a trial a year or two ago, but were compelled to abandon the experiment, on the ground that it could not be made to pay.

BY THE WAY.

A LEARNED commission of German experts has arrived at the following definition of a boiler explosion:—"A steam boiler explosion takes place when the walls of a boiler undergo, through the working of the boiler, a rupture in such a way that, through an outburst of water and steam, a sudden equalization of the pressures interior and exterior to the boiler occurs." That is to say, a steam boiler explosion is what takes place when the boiler bursts!

x x x x

WE are told that instead of the word "Hello," which has come to be the recognized introductory to a con-

offering for sale a complete line of electric heating and cooking appliances, manufactured by the American Electric Heating Corporation of Boston. These appliances have been worked out very carefully in detail, so as to secure the greatest possible durability and economy in operation, and seem likely to find a very wide market throughout the Dominion, especially at points where a day service is furnished by the local lighting company. The convenience, cleanliness and general desirability of electrical appliances for heating and cooking will be recognized, while at the prices at which current is sold now-a-days, their economy is sufficiently high to admit of their having in the immediate future a wide field for usefulness. We present a cut showing an assortment of these appliances, which include a wide range of articles for different purposes, including room heaters, car heaters, baking ovens, chafing dishes, five o'clock tea sets, portable stoves, broilers, sad irons, curling tong heaters, tailors' irons, hot water urns, glue pots, and a great number of equally useful articles.

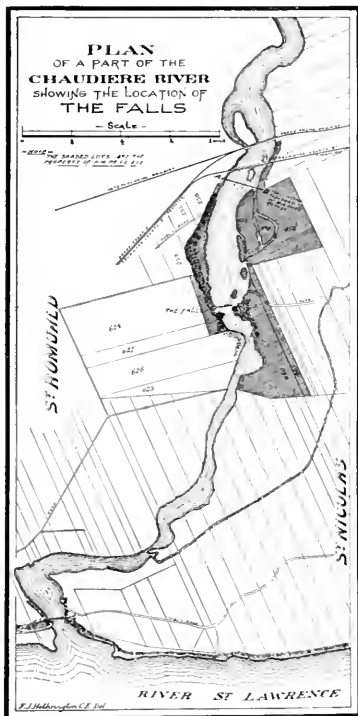
TORONTO TECHNICAL SCHOOL EXAMINATIONS.

WE print below a copy of the examination papers in Electrical Engineering and Steam and Steam Engine, submitted to students of the Toronto Technical School at the close of the session, these subjects being under the direction of Mr. Jas. Milne. In our July issue we hope to publish correct solutions of the questions, and students and others interested are asked to work out the problems and compare their results with the answers to be given.

ELECTRICAL ENGINEERING.

200 marks will constitute a full paper. The value attached to each question is shown in brackets.

1. What data do you require for determining the amount of current as measured by the Tangent or Sine galvanometer? Work out the formula, and make the necessary sketches to illustrate your answer. [25]
2. How would you determine the value of an unknown resistance if you were supplied with a Weston voltmeter, the resistance



of which is known, together with a known E.M.F. and whatever wires, etc., are necessary for making the necessary connections? If voltmeter has 20,000 ohms R_v and the E.M.F. is 500 volts, when the unknown R is put in circuit voltmeter shows 375 volts, what is the value of the resistance? [25]

3. With a shunted galvanometer, when a resistance of 1 megohm was in circuit, a deflection of 10° was observed when battery key was pressed. With same battery and shunt removed, there was a deflection of 5° when a certain resistance was in the circuit. Determine the value of the resistance. The resistance of the galvanometer was 7,020 ohms, and the shunt was 1/100th. Omit in the calculation the battery resistance. Make a sketch of the arrangement, and show clearly how you arrive at your results. [30]

4. The electro-chemical equivalent of zinc is .00034. What do you understand by this? What would be the deposit in an Edison chemical meter, the German silver shunt having a resistance of .01 ohms, and the resistance of the voltmeter and the coil in series with it is 48.96 ohms, when a current of 100 amperes has been passing for 4 hours. Make a diagram showing the arrangement. [35]

5. In an Edison underground 3-wire system, the distance from power-house to feeder junction box is 6,000 feet. The copper resistance is .017 ohms per 1,000 feet. The two outside wires are looped together at one end (the junction box), and at the other the ends of the loop are attached to the terminals of a galvanometer. A 150-ohm resistance coil of 200 turns is also connected to the terminals of the galvanometer, and at a distance of 20

turns from one end one pole of a 4-cell battery is attached, the other pole being attached to ground. In this position there is no deflection of the needle. Find the location of the fault, and give distance in feet from the power-house. [35]

6. What is the size of the conductor in the above question? [25]

7. What data would you require to determine the permeability of an electro-magnet core which lifts a weight of P pounds? Investigate a formula. What do you understand by permeability? [40]

8. A current of 20 amperes, flowing through a resistance of 10 ohms, heats 20 lbs. of water from 60° to 70° Fah. How long was current flowing, supposing there was no loss by radiation? [30]

9. What is the efficiency of an electric motor when running up to its maximum? Prove it. [30]

10. Describe the Aron or Thomson wattmeter. [30]

11. Make a diagram showing the connections in the Brush or Thomson-Houston arc dynamos. Make sufficient sketches to fully illustrate the changes that take place in one revolution. Also describe some form of regulator for arc machines. [30]

12. What does the torque of a motor depend on? Prove your statement. [30]

13. What do you understand by the "Constant" of a galvanometer? What data do you require in determining it? Give an example, and show clearly what is meant by it. [30]

STEAM AND STEAM ENGINE.

ELEMENTARY.

115 marks will constitute a full paper.

1. Distinguish between heat and temperature. What are the units by which each are measured? How many units of heat are required for raising 1 lb. of water from 32° F. to 212° F. and then evaporating it into steam? How much mechanical work would be done in each operation? [15]

2. Steam expands in the cylinder of an engine from a pressure of 35 lbs. above to 5 lbs. below atmosphere; at what part of the stroke was steam cut off? Find the mean pressure, taking 15 lbs. per square inch as atmospheric pressure. [15]

3. Sketch in section the parts of a steam cylinder, and show by means of three separate sketches any form of slide valve you prefer to illustrate, wherein (1) the valve has no lap; (2) the valve has lap on steam side; (3) the valve has lap on both steam and exhaust sides. In each drawing the valve must be shown in its mid position. [15]

4. What diameter of a cylinder will be required to develop 60 h.p. in a non-condensing engine. Stroke 3 feet, 60 revolutions per minute. Initial gauge pressure, 60 lbs. Cutting off at 1/5 stroke. [15]

5. A safety valve, 3" diameter, is held down by a uniform lever and weight. The lever is 30" long and weighs 10 lbs., and the valve weighs 4 lbs.; distance from fulcrum to centre of valve, 4". If the weight at the end of the lever is 60 lbs., at what pressure will the valve be lifted? Make a sketch showing the valve, seating, and the general arrangement. [15]

6. What do you understand by jet and surface condensation respectively? Give a sketch of each arrangement. In a surface condenser there are 1,000 brass tubes, each 6 feet long and 1 inch outside diameter; what amount of cooling surface would such a condenser provide? Allowing 3 square feet per horse power, what would be the rating of it? [15]

7. Sketch a link motion reversing gear for a locomotive or marine engine, and explain how the reversal is effected. [20]

8. Taking steam at 50 lbs. above that of the atmosphere, sketch three diagrams showing the amounts of work obtained from a given weight of steam: (1) when used in an engine without expansion or condensation; (2) when the steam is cut off at 1/3 stroke, but not condensed; (3) when cut off at 1/3 stroke and condensed. [20]

9. Make a sketch showing the setting of a return tubular boiler. Which of the seams are double rivetted and which of the seams are single rivetted, and why? [20]

10. What is the height of the cone of an ordinary pendulum governor which makes 80 revolutions per minute? Make a diagram of the arrangement, and show how the movement at the governor is communicated to the throttle valve. [20]

11. If 200 tons be lifted 6' in 10 minutes by a steam engine, wherein the diameter of the piston is 20", the mean pressure on the piston is 20 lbs. per square inch, length of stroke 4', and the number of double strokes 15 per minute. What proportion of the power applied is lost in the working of the machinery? [15]

ADVANCED.

200 marks will constitute a full paper.

12. The steam ports in a cylinder are 2 1/2" wide, the lead of the valve is 1/8", outside lap 1 1/4", inside lap 1/8". Valve travel, 5 1/4". Determine the maximum openings for steam and exhaust. [25]

13. The stroke of an engine is 24"; connecting rod, 4' long; valve travel, 4"; outside lap, 1"; inside lap, 1/8"; lead, 1/8". Find the positions of the piston at the points of cut-off, release, compression, and admission respectively. Draw the hypothetical indicator diagram which such an engine would afford. [30]

14. The diameter of a steam cylinder is 8"; piston stroke, 18"; number of revolutions, 150 per minute; initial pressure, 85 lbs. gauge; cut-off, 1/3 stroke; 3 lbs. back pressure above atmosphere. Find h.p. h.p. log $s = 1.64$. The same engine is tested by a brake pulley on crank shaft 5" diameter, the effective load being 260 lbs., radius 2 1/2 feet. Find the Brake h.p. and the working efficiency of the engine. [25]

15. In a marine engine fitted with surface condenser the steam reaches the condenser at a mean absolute pressure of 3 lbs. per

square inch, and is condensed to water at 120° Fah. How many pounds of circulating water, which enters at 60° Fah. and is discharged at 100° Fah., would be required for every pound of steam condensed? The temperature of steam at 3 lbs. pressure being 142° Fah. [30]

16. Explain the effects of inside and outside "lap," "lead," "cushioning," "wire-drawing," and "release" on the indicator diagrams, making such sketches as may be necessary to render your answer clear. Mark on your diagrams the points of admission and cut-off. [25]

17. Explain clearly in what manner and to what extent clearance will affect the indicator diagram of an engine. What would be the difference in the diagram of an engine working with steam at 100 lbs. absolute, cutting off at 125 stroke, when the volume of the total clearance in cylinder and in passages is equal to $\frac{1}{16}$ th and $\frac{1}{16}$ th respectively of the contents of the cylinder? [30]

18. How would you combine into one diagram the indicator cards from the two cylinders of a compound engine? State fully what data you would require in addition to the actual cards. [30]

19. Given Unwin's proportion $d = 1.2 \sqrt{t}$, determine the pitch, size of rivets, together with the relative strengths of single, double and triple rivetted joints for $\frac{3}{4}$ " plate, assuming that the shearing strength of the rivet is equal to the tensile strength of the plate. [35]

20. In a boiler 25' long and 7' diameter, having two flues 30" diameter, find the bursting pressures in the longitudinal and transverse seams, if the ultimate strength of the double and single rivetted joints are 35,000 and 28,000 lbs. per square inch respectively, thickness of plate $\frac{1}{2}$ ". [30]

21. In the city of Toronto a boiler test was being conducted, and it was found that the average evaporation for 10 hours was 4,000 lbs. water per hour, and the average hourly consumption of coal was 400 lbs. The water was supplied from the city mains at 40° Fah., after which it was pumped through an exhaust steam heater, which raised the temperature to 200° Fah. At this temperature the water entered the boiler. The average gauge pressure was 150 lbs. If the calorific value of the coal is 12,800 B. T. U. per pound, calculate the efficiency of the boiler, and taking what is known as the Centennial Standard as a basis of computation, find the horse power of the boiler. What is the equivalent evaporation from and at 212° per pound of coal, and what is gained by having the feed water heater? The temperature of steam at 150 lbs. pressure is 366° Fah. [50]

22. In a triple expansion engine the ratio of the cylinders are as 1:2 $\frac{1}{2}$:6, and the M. E. P. brought to a low pressure cylinder basis is 30 lbs. Find the M. E. P. on each piston, so that all three cylinders will be doing exactly the same amount of work, the stroke being the same in each case. If the area of the L. P. cylinder is 407 $\frac{1}{2}$ sq. in., what is the diameter of the high and intermediate cylinder? [25]

23. Sketch and describe the action of the indicator for measuring the power of an engine. The scale of an indicator diagram is 60 lbs. to the inch, the area of the diagram 4 square inches, and the greatest length parallel to the atmospheric line is 2.5', the crank 15", the diameter of the cylinder 15", and the number of revolutions per minute 80. Find the I. H. P. [25]

TRADE NOTES.

Mr. Edward Slade has recently commenced business at No. 137 St. John street, Quebec, as an electrical engineer and contractor.

Messrs. Geo. White & Son, the enterprising proprietors of the Forest Machine Works, London, have moved into their new machine shops, which have been thoroughly refitted. They report good business in their line, and excellent prospects.

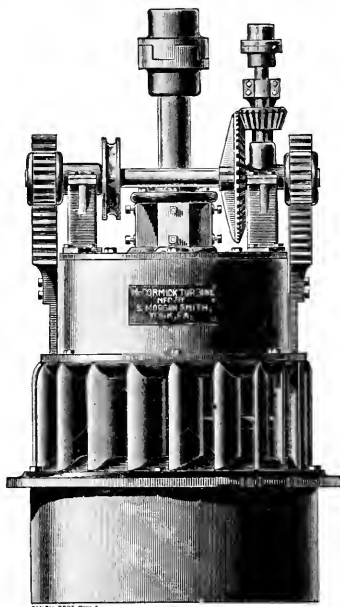
Messrs. Collyer & Brock, electrical engineers and contractors, of Montreal, have been retained by the Stadacona Water, Light and Power Company, as consulting and supervising engineers in the installation of an electric light and power plant in the town of Huntingdon, Que. A fine water power is being developed on the Chateauguay river, and the plant will be operated on the 220-volt direct current system. They expect to have the plant in operation by the first of June.

W. A. Johnson Electric Company, 34 York st., Toronto, report the following sales made during the last 60 days, and not previously reported:—Thos. B. Angrove, Kingston, Ont., 3 h.p. motor; Theo. Fredrick, Ottawa, Ont., 1 h.p. motor; Antelope Bicycle Works, Toronto, 12 h.p. motor; Nasmith & Co., Toronto, 4 h.p. motor; D. Hibner & Co., Berlin, 150-light incandescent plant; W. J. Miller, saw mill, Thessalon, Ont., 30-light incandescent plant; Grip Engraving Co., Toronto, 8 h.p. motor; Murray Printing Co., Toronto, four 3 h.p. motors; Luxfer Prism Co., Toronto, one 600-ampere dynamo for depositing copper, and one 4 h.p. and one 6 h.p. motor; McLaren & Co., St. Catharines, one 3 h.p. motor; Rat Portage, Ont., two 3 h.p. and one 5 h.p. motor; New Denver Electric Co., 500-light incandescent plant complete; Rat Portage Electric Co., 100 arc light automatic dynamo and lamps, one 4-panel marble plug switchboard 12 x 5 for four alternating dynamos and eight circuits, and for one arc dynamo and one power generator; Waterloo Electric Co., 1,000-light incandescent plant complete, with wiring for residences, stores, etc., 25-light arc plant complete with long-burning arc lamps, and one marble switchboard; Macgregor, Gourley & Co., Galt, Ont., two power generators, two 8 h.p. motors, two 6 h.p. motors and wiring for incandescent lamps, one marble switchboard panel. Messrs. W. A. Johnson Electric Co. further report that they have also made many sales of their long-burning arc lamps for direct and alternating circuits, chloride accumulators, Wagner transformers, etc.

MCCORMICK TURBINES.

YORK is one of the many noted manufacturing centres in Pennsylvania, and prominent among the manufacturing plants found in that city is that of the S. Morgan Smith Company, whose works were illustrated in our March issue. The buildings are chiefly of stone and brick, and are more than 1,100 feet long, and cover several acres of ground. This plant has been built within the past six years and equipped with new and modern machinery.

The many railroad tracks, travelling cranes and elevators in use upon the premises and within the buildings are so well placed that all articles of machinery manufactured, whether in their crude or finished condition, up to 60,000 pounds weight, are handled as readily as a farmer handles his ploughs upon the farm, or the merchant his goods in the store. The plant is supplied with the latest and most improved machine tools, such as boring mills, pit lathes, shafting lathes, planers and whatever else is needed in the construction of turbine water wheels, iron flumes shafting, pulleys, gearing, steam boilers, etc.—some of the boring mills and pit lathes being large enough to allow of pulleys, rope sheaves and fly-wheels being turned off and bored out, as great as 25 feet in diameter and six feet wide upon their face. There are also some remarkably large and fine machine tools for cutting



and dressing gear wheels up to 20 feet in diameter and as much as 30 inches on the face.

On looking through this shop and noting the many massive and modern tools it contains and the conveniences for handling every article manufactured, one readily understands why it is that the McCormick and New Success water wheels and other machinery for cotton, paper, pulp, flour and saw mills, so extensively built and sold by the S. Morgan Smith Co., give such excellent satisfaction.

The company is composed of father and three sons, who own nine-tenths of the plant. All of them are hydraulic and mechanical engineers, as well as practical business men. These facts explain why it is that the buildings composing the shops are so well constructed and arranged, why all the railroad tracks, travelling cranes, trolley lines, elevators, boilers, engines, cupolas for iron and brass foundries and great lathes and boring mills, are each and all seemingly located just in the right place. An important feature in the plant is the many windows in the ceilings and walls, flooding every department through the day with light, and at night the whole is illuminated with arc and incandescent lights, supplied by the company's dynamos. Large sums have been spent in improving and testing these water wheels, and in this way they know the speed and power of each size of their water wheels so perfectly, that when informed as to what power is needed, and head of water available, they claim never to make a mistake in the size and number of water wheels required to operate the plant to the best advantage.

The McCormick wheel is the invention of John B. McCormick,

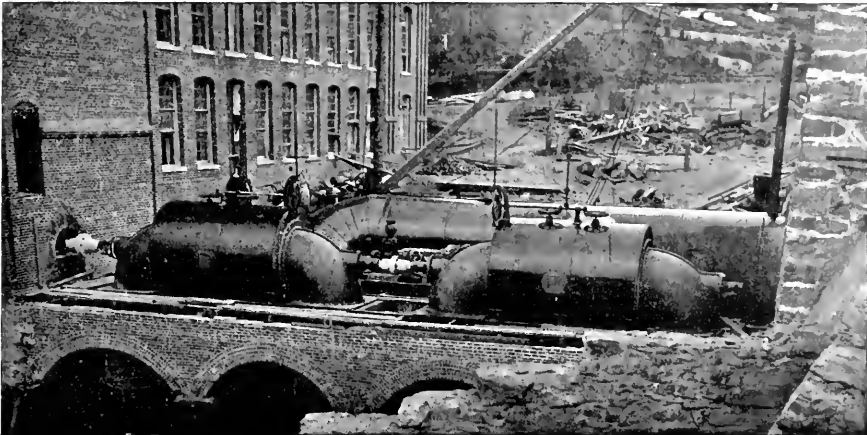
who also invented the Hercules wheel and did much toward the designing of the Victor wheel. The McCormick is his latest invention, and embodies new points of merit in its construction. It is very heavy, strong, well-built and nicely finished. It is a cylinder gate wheel. The gate consists of a ring or cylinder, which is raised or lowered by means of the gate operating device, thus regulating the flow of water to the runner. The guides through which the water passes to the runner are stationary. The gate is balanced, thus making it operate very easily. Hundreds of these wheels are in operation throughout the world, driving all kinds of machinery. A great many have been sold in Canada. The following is a list of some people in Canada who

CORRECTION.

By inadvertence in the advertisement of the Canadian General Electric Company appearing in our April issue, the two 600 horse power railway generators which they are supplying for Quebec are credited to the Quebec District Railway instead of to the Montmorency Electric Power Company, who are furnishing the power for the system.

PERSONAL.

Mr. F. X. Moisan, president of the Merchants' Telephone Company, Montreal, died in that city last month from paralysis. At a special



This engraving represents two pairs of horizontal 42-inch McCormick turbines, mounted in iron cases on horizontal shafts. They are coupled together, and the power is taken off at one end of the water wheel shaft, which extends into the mill, by three rope sheaves to feet in diameter, having 45 grooves for 1 1/2-inch ropes. There is also a 27-inch McCormick turbine on horizontal shaft, direct connected to a 1,000-gallon fire pump. This turbine also drives the dynamo. The combined power of these turbines is 2,355 horse. The water is supplied to the turbines by two pipes to feet in diameter, which are attached to the sides of the wheel cases. The entire outfit was built and erected by the company at the new No. 3 mill of the Clifton Manufacturing Co., Clifton, S. C.

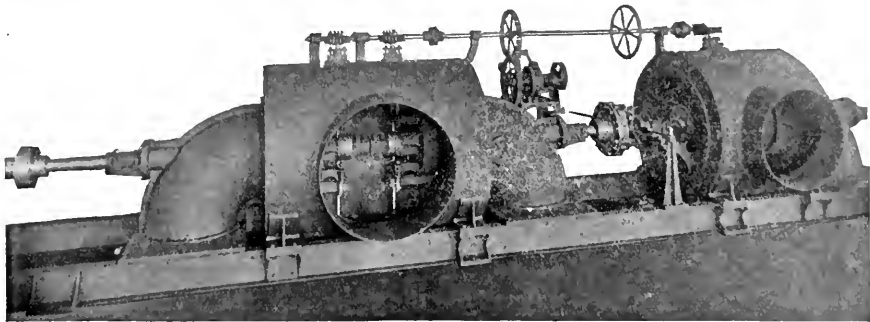
are using McCormick wheels furnished by this company:—Sault Ste. Marie Pulp and Paper Co., Sault Ste. Marie, Ont., 18 vertical 51-inch; E. B. Eddy Co., Hull, Canada, 2 pairs of horizontal 42-inch; Riordan Paper Mills, several different sizes; the Montreal Cotton Co., Valleyfield, Quebec, 2 60-inch, together with gears and shafting, and a duplicate of this order now being built for the same company; municipality of Valleyfield, Que., a 60-inch, together with gears, shafting, friction clutches, etc.; Milton Pulp Co., Milton, Nova Scotia, 4 33-inch; Morgan Falls Pulp Co.,

meeting of the board of directors, resolutions expressing sympathy with the family were passed.

Mr. William Westhead, engineer of the McClary Mfg. Co.'s works at London, Ont., died of apoplexy recently, after a few hours' illness.

Mr. Henry N. Bartlett, inspector of the Ottawa Electric Railway Company, has severed his connection with the company to accept a position in Montreal.

Messrs. James Ross and Granville C. Cunningham, of the Montreal Street Railway Company, returned a fortnight ago from a trip to



This engraving represents one pair and one single 27-inch McCormick turbines, mounted on horizontal shafts in iron cases, operating under 64-feet head, the ice manufacturing plant of Chas. T. Westcott, Baltimore, Md. By means of the Worrall friction clutch between the pairs and the single wheels, the latter can be disconnected from the former, when it becomes necessary, owing to lack of water, to operate but two wheels. A shaft about 50 feet long is connected with the shaft of the turbines and on the extreme end it is a rope sheave, from which the power is transmitted to another rope sheave, located in the mill, about 200 feet distant. The water is supplied through a pipe about 125 feet long. The entire outfit was built and placed in position by this company.

New Germany, N. S., 3 33-inch; Sissiboo Falls Pulp Co., Weymouth Bridge, N. S., 1 45-inch, 1 27-inch and 2 33-inch; Farnham Electric Light Co., Farnham, Quebec, 42-inch; G. K. Nesbit, Cowansville, Que., 1 27-inch, etc.

INTERESTING AND USEFUL.

Mr. P. H. Dickenson, of the Brantford Electric Company, in renewing his subscription to the ELECTRICAL NEWS, states that he is much pleased with the publication, and finds it very interesting and useful reading.

England. On being asked if there was anything in the report that Canadians would enter new fields of electrical work in England, the latter remarked that these reports were premature, but that if good opportunities presented themselves, he had no doubt that those who were alive to electric railway possibilities in Canada would again go into the business abroad.

It is estimated that a good railway engine will travel about 1,000,000 miles before it wears out. However, the life of an engine depends as to its length upon the treatment it receives. With ordinary care it ought to last twelve years.

INCANDESCENT DYNAMOS.*

BY G. W. MACKIE.

We as engineers are often called upon to take charge of a dynamo for shop lighting, therefore I think a little study in this direction will be profitable. Before considering the dynamo, let us see what relation electricity and magnetism bear to each other. If we take a piece of iron (Fig. 1) and wind a few turns of insulated or covered wire upon it, and then pass a current through the wire, we will find the iron magnetized, or having the power to pick up pieces of iron and steel; and the more current we apply the stronger will be the magnetism up to a certain point. But bear in mind that just as soon as the current is stopped the iron loses its magnetism. Then again, if we take two horse shoe mag-



FIG. 1.

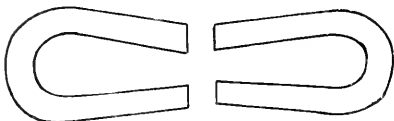


FIG. 2.

nets (Fig. 2) and place them end to end, so that the magnetism will flow from one to the other, then pass a piece of wire rapidly up and down between them, it will become hot from generating a current, thus showing us that electricity and magnetism go hand in hand. The principal parts of a dynamo are as follows, viz., armature, commutator, field magnets and brushes. The armature consists of a drum built up of iron discs, on which are wound coils of wire at right angles to the pole pieces P. The coils, revolving rapidly between the pole pieces, "thereby cutting through the magnetism," generates a current, which is passed out to the commutator. The commutator C is composed of a number of

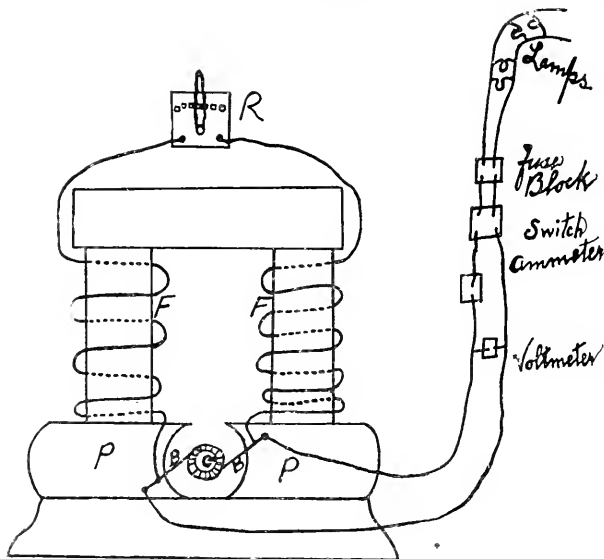


FIG. 3.

bars of copper, insulated one from another. If we had not a commutator, just a plain ring, we would then have an alternating current, but with the use of the commutator we straighten the current so that it will flow in one direction.

Field magnets F is an iron core on which is wound many turns of fine wire, so that when part of the current of the machine passes through this wire it will magnetize them; and the more current we pass through this wire the stronger will be the magnetism of the pole pieces. The brushes B are either copper or carbon.

Resting on the commutator, they carry off the current generated in the armature and pass it into the circuit.

There are two kinds of machines used for incandescent lighting—shunt and compound. In a shunt machine (Fig 3), the current leaves one brush, passes around one field magnet, through a reostat, or resistance box R, around the other field magnet, back

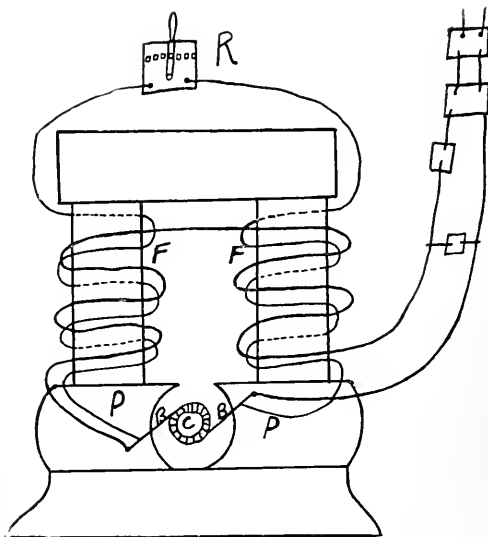


FIG. 4.

to the other brush. To regulate this machine, we move handle of reostat so as to put more or less resistance to the current flowing in field magnets. This reostat is composed of a number of coils of German silver wire, "which has a high resistance to the current," and by moving the handle of reostat we put a greater or less length of this wire in the field wire, thereby varying the resistance. Supposing we were carrying 50 lights, and then added 50 more, we would require more current. To get this extra current we move handle of reostat so as to cut out some of the resistance, which would let more current flow in the field magnets, making the pole pieces stronger, and the armature, revolving in stronger magnetism, would generate more current. With this machine we would have to regulate for every change of load.

A compound machine (Fig. 4) has the shunt or fine winding the same as the shunt machine, but in addition, has a few turns of heavy or series wire, as shown by the heavy lines (Fig. 4) on field magnets—the light lines showing shunt winding. This heavy or series wire leaves one brush, passes around both field magnets, then to the circuit. With this machine, we bring it up to voltage by reostat; then it takes care of itself. Whatever current passes to the circuit has first to pass around the field magnets, and the more current flowing to the circuit the stronger will be the magnets. Then again, the less lights we have on the less current will be flowing; thereby the field magnets will be weaker. This machine will regulate itself from full load to no load. In the circuit we have a volt meter, to register voltage or pressure; an ammeter, to give quantity of current flowing; a switch, to open and close the circuit; a fuse block, in which is placed two pieces of soft wire, so that in case of a short circuit or overload, it will burn out this wire and save the machine.

Some of the causes of sparking are:—Carbon brushes becoming glazed, making a poor contact with commutator—this should be sand-papered off; brushes not set at neutral point; brushes not exactly opposite each other; brushes making contact with too many sections of commutator; some of the armature coils short-circuited; rough commutator; copper dust between sections of commutator; loose connection in commutator; machine overloaded.

*Paper read before Hamilton Association No. 2, C.A.S.E.

ELECTRIC RAILWAY DEPARTMENT.

IMPROVED RAILWAY CARS.

THE Toronto Railway Company have in course of construction at their car shops in Toronto twenty open cars, to be known as "Jubilee cars," the intention being to have them ready for operation on the Queen's birthday. They are 27 feet long and seven feet six inches wide, the additional length permitting of more room between the seats. Each car will have a seating capacity for 70 persons, and will be fitted with C. G. E. motors and Blackwell trucks. The sills which support the steps are of Georgia pine, the cross sills and floor of oak, the posts of ash, the seats of maple and cherry, and the roof of cherry and basswood, covered with canvas and coated with fire-proof paint. Iron panels support the seat on each side.

A new feature of these cars will be the double steps at the sides. Bicycle racks will be fitted on the back of each car. The cars will be painted white with a gold finish, and each will weigh about ten tons. The manager of the Street Railway Company considers that these will be the finest open cars in America. It is also the intention of the company to build twenty more open cars and ten large moonlight excursion cars, the latter to be ready by Dominion Day.

LEGAL DECISIONS.

DAVIS VS. OTTAWA ELECTRIC RAILWAY COMPANY.—John Davis, of Ottawa, recovered \$200 damages in an action against the Ottawa Electric Railway Company for being forcibly ejected from a street car because his foot was on an opposite seat and he refused to remove it at the request of the conductor. The railway company appealed from the verdict to the Divisional Court at Osgoode Hall and the verdict was set aside. During the argument an interesting discussion ensued between council and the court upon the right of passengers in railway trains and street cars to put their feet upon the opposite seats. Counsel for Davis contended that if there was room in the car a man with clean boots on had a right to put his feet on the opposite seat. Chief Justice Armour pointed out that this would lead to fine distinctions as to what boots were clean and what were not, and expressed the opinion that he would feel inclined to put a man off the car if he would not take his feet down. It appeared in evidence that Davis had just had his boots cleaned before getting on the car, but the verdict was nevertheless set aside.

CITY OF KINGSTON V. KINGSTON, PORTSMOUTH & CATARAUGUS ELECTRIC RAILWAY CO.—Judgment in action tried without a jury at Kingston. The action was brought to compel the defendants to run their cars during the winter months as well as the rest of the year over the portion of the railway from Alfred street along Princess street westward to the city limits, in accordance with the terms of the agreement between the plaintiffs and defendants. Held, that in the face of the line of authorities referred to in the judgment of Ritchie, C. J., in *Bickford v. Chatham*, 16 S.C.R., 235, a judgment for specific performance could not be pronounced, because such a judgment would necessarily direct and enforce the working of the defendants' railway under the agreement, in all its minutiae for all time to come. Held also, that the enforcement of a judgment for the performance of a long series of continued acts involving personal service, and extending over an indefinite period, would be equally difficult if the judgment were in the form of mandamus. The plaintiffs were not entitled to the prerogative writ of mandamus, because that writ is not obtainable by action but only by motion. Held also, that to grant an injunction restraining the defendants from ceasing to operate their cars on the part of line in question would be to grant a judgment for specific performance in an indirect form, and that a declaration of right under sec. 52, sub-sec. 5, of the judicature should not be made, as the terms of the contract were plain and were confirmed by statute, and the only difficulty was that of enforcing them. Held lastly, that no evidence of any actual damage having been offered a reference could not be directed. Action dismissed with costs.

SPARKS.

Kirkton citizens are asking for the construction of an electric railroad from London via Bryanson and Granton.

The Cornwall Electric Street Railway Company will probably be given the contract for lighting the streets of Cornwall by arc lights.

It is expected that the electric street railway at Quebec will be in working order early in June. Mr. Evans, manager of the road, has a large staff of men at work.

The Railway Committee of the Dominion parliament have refused to allow the Hull and Aylmer Electric Railway Company to operate their cars on the streets of Ottawa.

The bill to incorporate the Toronto Radial Railway Company, promoted by E. A. Macdonald and Frank Pedley, was thrown out at the recent session of the Ontario legislature.

Messrs. D. B. MacLennan, Q.C., and J. T. Kirkpatrick have been elected directors of the Cornwall Electric Street Railway Co., vice Mrs. H. R. Hooper and Mr. F. N. Seddall, resigned.

Mr. R. H. Fraser, manager of the Toronto and Suburban Electric Railway, is at present in the gold mining regions of the Rainy River district, where he is interested in several claims.

The project of an electric railway from Hamilton to Beamsville, to connect with the H. G. & B. electric road, is still under consideration. Mr. J. S. Campbell is one of the promoters.

A syndicate is still negotiating with Col. Stacey, of St. Thomas, to electrify the street railway in that town. The same parties are said to be considering the construction of an electric railway from London to Port Stanley.

Mr. Auld, of Amherstburg, Ont., has filed plans in Toronto of the proposed railway to be built from Amherstburg to Windsor. A rival company has also filed plans for a similar road, which would indicate that a bitter fight between the two companies might develop.

W. G. Walton, president of the Hamilton & Barton Incline Railway Company, has invented a power transmitter which gives a motor vehicle a speed of from 4 to 24 miles an hour. All the machinery is hung on the frame separate from the body, so that no jar will be felt.

The shareholders of the Montreal Street Railway Company have authorized the directors to issue new stock to the extent of one million dollars, to provide for further expenditure in connection with the extension of the company's lines and the increase of rolling stock, plant, etc.

Mr. D. McDonald, superintendent of the Montreal Street Railway, has received a resolution from the Woman's Club, thanking him for the courtesy with which he received and acted upon their request that stringent measures should be taken to prevent the practice of expectoration in the street cars.

At the last session of the Ontario legislature incorporation was granted to the Ingersoll Electric Radial Railway Company, to construct an electric railway from Ingersoll to St. Marys, Tilsonburg and Brownsville, with power to build telegraph or telephone systems. The capital stock is placed at \$500,000.

The franchise of the Lower Town Street Railway at Quebec has been finally sold to the new electric railway company for the sum of \$20,000. The old company retain their buildings, horses, cars, rails, etc., and have permission to run their cars until the electric road is ready to commence traffic in Lower Town and St. Roch.

The Montreal and Bout de L'Isle Railway Company has secured the contract to carry the mails from Maisonneuve to Longue Pointe, Point aux Trembles and Bout de L'Isle, suburbs of Montreal, the contract in question calling for a service twice a day each way. Two new eight wheeled cars have just been finished for the road by the Ottawa Car Company.

The annual meeting of the Hamilton Radial Electric Railway Company was held at Hamilton on the 5th of April, when a contract was let to extend the road through Burlington to Brant street. The following were elected directors: A. Turner, president; T. Leather, vice-president; J. E. Malloch, managing director; W. A. Wood, treasurer; J. Dixon, George Staunton, T. H. Watson, J. Moody.

The residents of the village of St. Louis du Mile End, a suburb of Montreal, are not satisfied with the service afforded by the Montreal Park and Island Railway, and as a result Mr. Albert E. Lewis, real estate agent, has entered an action against the village claiming \$50,000 damages from the corporation for not compelling the railway company to provide a more efficient service. The plaintiff claims that his property has been depreciated in value by lack of speedy transportation.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the program as outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obscure and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SOLID ARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

Wm. THOMPSON.

COMMON FRACTIONS.

A FRACTION is one or more of the equal parts into which a unit, or that which is considered as a whole, may be divided.

[NOTE.—Thus a two foot rule is divided into $\frac{1}{2}$ ft., $\frac{1}{3}$ ft., $\frac{1}{4}$ ft., $\frac{1}{8}$ ft., and so on, and consequently this style of numeration is constantly occurring in mechanical engineering.]

The terms of a fraction are styled and distinguished as the Numerator and the Denominator.

The numerator of a fraction indicates the number of parts of the unit considered or taken.

The denominator indicates the number of parts into which the unit is divided.

To express a fraction is to indicate by figures the number of parts in the numerator and denominator respectively above and below a horizontal line.

Thus $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$.

Common Fractions are known as Simple, Compound and Complex.

A simple fraction is a fraction whose numerator and denominator consist of simple numbers.

Thus $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$.

A compound fraction is a fraction whose value is not fully expressed, but must be arrived at by computation.

Thus $\frac{1}{2}$ of $\frac{1}{3}$, $\frac{1}{4}$ of $\frac{1}{8}$, etc.

A complex fraction is one which contains a fraction in the numerator or denominator, or in both. Its value must be found by computation.

Thus $\frac{\frac{1}{2} \text{ of } 6}{\frac{2}{3} \text{ of } 1}$ $\frac{\frac{1}{2} \text{ of } \frac{1}{3} \text{ of } 4}{\frac{1}{2} \text{ of } 6}$

The numerator or figures above the line correspond with the dividend, and the denominator or figures below the line with the divisor.

The chief principles relating to fractions are:

1. Multiplying the numerator by any number multiplies the fraction.
2. Multiplying the denominator by any number divides the fraction.
3. Dividing the numerator by any number divides the fraction.
4. Dividing the denominator by any number multiplies the fraction.
5. Multiplying both numerator and denominator by the same number does not affect the value of a fraction.
6. Dividing both numerator and denominator by the same number does not affect the value of a fraction.

Giving us the important general principle that any change in the numerator produces a corresponding change in the value of the fraction, and any change in the denominator produces an opposite change in the value of the fraction.

COMMON DENOMINATOR.

A common denominator is a denominator which is common to two or more fractions.

Rule: To find a common denominator to two or more fractions, multiply together all the denominator and the product will be the common denominator.

Example: Find common denominator of $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{8}$ = The denominators multiplied together, as $2 \times 3 \times 4 \times 8 = 320$, which becomes the denominator common to the whole of these fractions.

This rule often entails a lot of work, consequently I prefer to

reduce denominators to their simplest form and multiply together the final quotient and the divisors, which will give the common denominator in lowest form.

Example: Find the common denominator of

$\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{8}$.

Reduce denominators to lowest form, thus:

$$\begin{array}{r} 3 \overline{) 6 \cdot 8 \cdot 32 \cdot 3 \cdot 5} \\ 2 \overline{) 2 \cdot 8 \cdot 32 \cdot 1 \cdot 5} \\ 4 \overline{) 1 \cdot 4 \cdot 16 \cdot 1 \cdot 5} \\ 1 \cdot 1 \cdot 4 \cdot 1 \cdot 5 \end{array}$$

Then by multiplying final quotient and divisors together, thus, we get

$$5 \times 1 \times 4 \times 1 \times 4 \times 2 \times 3$$

Since, however, single units do not in any way effect results we write it

$$5 \times 4 \times 4 \times 2 \times 3 = 480 \text{ C. D.}$$

Rule: To reduce two or more fractions to equivalent fractions having a common denominator, divide the common denominator by the denominator of the given fraction, multiply the quotient so found by their numerators, and write the results over the common denominator.

Reduce to equivalent fractions having a common denominator.

$\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{8}$.

Since we have just found the common denominator of these fractions to be 480 we place it thus

$$\begin{array}{r} 400 \ 420 \ 225 \ 320 \ 384 \\ \hline 480 \end{array}$$

and proceed as in rule to divide the common denominator by the denominator of the first of our fractions, $\frac{1}{2}$, which equals $480 \div 2 = 240$. Proceeding again as by rule, we multiply this product by the numerator, 1, thus $240 \times 1 = 240$, which result we place in first position above the common denominator. Proceeding similarly with the other fractions in our example, we get a series of fractions having a common denominator and equivalent to the fractions from which we started computation.

ADDITION OF FRACTIONS.

Addition is the process of finding the sum of two or more fractions.

Principle involved: Fractions to be added must be reduced to equivalent fractions having a common denominator.

Rule: To find the sum of two or more fractions having different denominators, reduce the given fractions to equivalents with a common denominator. Add the numerators so found, and if their sum is greater than the common denominator divide the numerator by the common denominator and the result will be the sum of the given fractions.

Find the sum of $\frac{1}{2}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{1}{8}$.

Proceeding as before we find the common denominator to be 16, thus

$$\begin{array}{r} 4 \overline{) 16 \cdot 8 \cdot 4 \cdot 2} \\ 2 \overline{) 4 \cdot 2 \cdot 1 \cdot 2} \\ 2 \cdot 1 \cdot 1 \cdot 1 = 16 \end{array}$$

Proceeding exactly as before we find the equivalent fractions having a common denominator to be expressed thus:

$$\begin{array}{r} 5 + 14 + 12 \times 8 = 27 \\ 16 \text{ C. D.} \end{array}$$

Adding these numerators together, as in rule, we get the

fraction $\frac{39}{16}$. Now dividing the numerator 39 by the denominator 16 we get $39 \div 16 = 2\frac{7}{16}$, then our question may be expressed thus :

$$\frac{5}{16} + \frac{7}{8} + \frac{3}{4} + \frac{1}{2} = \frac{5+14+12+8}{16} = \frac{39}{16} = 2\frac{7}{16}$$

This principle underlies the whole subject of addition, and needs no further demonstration.

SUBTRACTION OF FRACTIONS.

Subtraction of fractions is the process of finding the difference between two fractions.

Principle involved: Fractions, to be subtracted, must be reduced to equivalents with a common denominator.

Rule: To find the difference between two simple fractions, reduce the fractions to equivalents having a common denominator and subtract the numerators, and reduce the result to its simplest form.

Find the difference between $\frac{7}{8}$ and $\frac{1}{16}$.

Proceeding as already described in addition of fractions, we get

$$\frac{7}{8} - \frac{1}{16} = \frac{14-1}{16} = \frac{13}{16}$$

It will be observed that the process is exactly similar to the process of addition, and exceedingly simple, requiring practically no explanation when we have mastered the principles.

MULTIPLICATION OF FRACTIONS.

Multiplication is the process of finding the product of two factors, one or both of which may be fractions.

Rule: To multiply a fraction by a fraction, multiply the numerators together and also the denominators, and reduce to simplest form.

Multiply together $\frac{1}{2} \times \frac{1}{2}$. Proceeding as per rules and multiplying the numerators together and the denominators likewise, we get

$$\frac{1}{2} \times \frac{1}{2} = \frac{1 \times 1}{2 \times 2} = \frac{1}{4}$$

Following out the principle set forth in clause 6 of our introduction, multiply together

$$\frac{4}{5} \times \frac{2}{3} \times \frac{7}{8} \times \frac{9}{16}$$

Following out this principle we proceed by a process of cancellation to reduce to simplest form, thus

$$\frac{4}{5} \times \frac{2}{3} \times \frac{7}{8} \times \frac{9}{16} = \frac{21}{64}$$

By applying this system of cancellation, based upon the principle set forth in clause 6, you will observe we materially shorten the process of calculation without in any way affecting the result.

Rule: To multiply a fraction by an integer or an integer by a fraction,

1. Divide the denominator of the fraction by the integer and place the result under the numerator, and reduce to simplest form, or

2. Divide the integer by the denominator of the fraction, and multiply the result by the numerator, or

3. Multiply the numerator of the fraction by the integer and place the result over the denominator. (See clauses 1 and 4 of principles).

Example (employing 1st method):

$$\text{Multiply } \frac{3}{8} \times 8 = 32 \div 8 = 4 = 4\frac{0}{8} = 4\frac{1}{2}$$

Example (employing 2nd method):

$$\text{Multiply } \frac{3}{8} \times 64 = 64 \div 8 = 8 \times 3 = 24 = 24\frac{0}{8} = 3$$

Example (employing 3rd method):

$$\text{Multiply } \frac{3}{8} \times 8 = 4\frac{0}{8} = 4\frac{1}{2}$$

It will be observed that the first of these methods can only be employed when the integer can be divided into the denominator an equal number of times, and the second when the denominator can be divided into the integer similarly, and the third method can be used at any time, but when either of the other methods can be used, lengthens the process, as is evidenced by calculation in this case. Employing method 1 and embracing principle 6, calculation would have been made as follows :

$$\frac{5}{8} \times 8 = 5$$

DIVISION OF FRACTIONS.

Division of fractions is the process of finding the quotient when either dividend or divisor is a fraction or mixed number, or when both dividend and divisor are fractions or mixed numbers.

Rule: To divide a fraction by an integer, divide the numerator or multiply the denominator of the fraction by the integer. The result will be the quotient. (See principles, clauses 2 and 3).

$$\text{Example: } \frac{3}{8} \div 4 = \frac{3}{32}$$

Rule: To divide an integer by a fraction, multiply the integer by the denominator of the fraction and divide the product by the

numerator, or divide the integer by the numerator and multiply the quotient by the denominator.

Example (by 1st method):

$$\text{Divide } 100 \div \frac{1}{4} = 400 \div 4 = 100 \times 4 = 400$$

Example (by 2nd method):

$$30 \div \frac{1}{4} = 120 \div 10 \times 4 = 40$$

Rule: To divide a fraction by a fraction, multiply the numerator of the dividend by the denominator of the divisor and set down the product as a new numerator, then multiply the denominator of the dividend by the numerator of the divisor and set down the product as the new denominator—reduce new fraction to simplest form, or

Invert the terms of the divisor and proceed as in multiplication of fractions.

Example: Divide $\frac{7}{8} \div \frac{1}{4}$ (following 1st rule). Since numerator of dividend is 7 and denominator of divisor 4, we get $7 \times 4 = 28$, which becomes new numerator or dividend.

Since denominator of dividend is 8 and numerator of divisor 3, we get $8 \times 3 = 24$, which becomes new denominator or divisor and giving $\frac{28}{24} = 1\frac{1}{6}$, that is, $\frac{1}{6}$ is contained in $\frac{7}{8} \div \frac{1}{4}$ times.

Employing 2nd method:

$$\frac{7}{8} \div \frac{1}{4} = \frac{7}{8} \times \frac{4}{1} = \frac{7 \times 4}{8 \times 1} = \frac{28}{8} = 3\frac{1}{2}$$

Again employing 2nd method and applying clause 6 of principles:

$$\frac{7}{8} \div \frac{1}{4} = \frac{7 \times 4}{8 \times 1} = \frac{7}{2} = 3\frac{1}{2}$$

It occasionally occurs in computation of formula that a fractional part of a fraction requires to be divided by a fraction or a fractional part of a fraction.

Rule: To divide a compound fraction by a compound fraction, first reduce the compound fraction to a simple fraction, and then follow rule laid down for dividing a fraction by a fraction.

Example: Divide $\frac{1}{2}$ of $\frac{7}{8}$ by $\frac{1}{4}$ of $\frac{1}{16}$.

To reduce compound fractions $\frac{1}{2}$ of $\frac{7}{8} \times \frac{1}{4}$ of $\frac{1}{16}$ to simple fractions, proceed as in multiplication of fractions.

Then $\frac{1}{2}$ of $\frac{7}{8} = \frac{1}{2} \times \frac{7}{8} = \frac{7}{16}$, and $\frac{1}{4}$ of $\frac{1}{16} = \frac{1}{4} \times \frac{1}{16} = \frac{1}{64}$; then question becomes a simple matter, since we proceed exactly as in division of fractions from this point.

Since dividend $\frac{1}{2}$ of $\frac{7}{8} = \frac{7}{16}$,

Since divisor $\frac{1}{4}$ of $\frac{1}{16} = \frac{1}{64}$,

$$\text{we get } \frac{7}{16} \div \frac{1}{64} = \frac{7}{16} \times \frac{64}{1} = \frac{7 \times 64}{16 \times 1} = \frac{28}{1} = 28$$

SPARKS.

An electric light plant will probably be installed at the consumptive sanitarium at Gravenhurst, Ont.

The Halifax Tramway Company have placed a large order for G. E. 1,000 equipments with the Canadian General Electric Company.

Mr. D. C. Dewar, recently manager of the Bell Telephone Company at Ottawa, was presented with a gold watch by the employees before his departure for Montreal.

The Hull Electric Company have placed an order for two 300 k.w. generators and several additional G. E. 1,200 and G. E. 51 equipments with the Canadian General Electric Company.

The Lachine Rapids Hydraulic & Land Company, of Montreal, have decided to issue \$750,000 of debentures. It was stated at a special meeting that one thousand horse-power of current had been sold to the Standard Light and Power Company.

Plans have been submitted to the Ontario and Dominion governments for the construction of a dam and lock across Ash Rapids, in the Lake of the Woods. It is proposed to utilize the water power so provided in generating electricity to light the mines and drive the power drills in the vicinity.

The Canadian General Electric Company have been awarded the contract for a 1,000 light incandescent plant by the corporation of Port Arthur. The plant, which is now being installed, will be of their standard single phase alternating type, and will be in operation in the course of two or three weeks.

Mr. E. J. Lennox, architect, has reported to the City Council of Toronto regarding the establishment of an electric plant at the new city buildings. He estimates that 700 horse power will be required to light the buildings, and 200 horse power for running the electric elevator. Should the plant be placed at the waterworks it would necessitate an extra boiler, while if placed at the buildings the exhaust steam could be utilized.

The Hamilton Radial Electric Railway Company are extending their system in the direction of Oakville. They have ordered four 45 ft. passenger cars from the Crossen Car Company, of Cobourg, which are to be models in every respect. These cars will each be equipped with a four motor equipment of G. E. 100 motors, for which an order has been placed with the Canadian General Electric Company. These four motor equipments are guaranteed to have a speed of 38 miles an hour, but with acceleration on the level will easily make from 45 to 50 miles, thus making the Burlington line, by long odds, the highest speed electric road in the Dominion.

SPARKS.

An electric light plant will probably be installed by the village of Exeter, Ont.

The Huntsville electric light plant, installed by the Canadian General Electric Co., was recently put in operation.

The Canadian General Electric Company have installed a direct-current lighting and power plant for Messrs. Bertram & Sons, Dundas, Ont.

The Finance Committee of the Hamilton City Council have passed the by-law for the conversion of the Hamilton and Dundas railway into an electric system.

The Canadian General Electric Company have sold a 1,000 light standard alternator to the Full Electric Light Company, Charlottetown, P.E.I.

The Montreal Island Belt Line Railway Company have ordered additional G.E. 1,000 and G.E. 1,200 equipments from the Canadian General Electric Company.

Mr. Fred Parkin, electrician for the Canada General Electric Co., Toronto, returned lately from River du Loup, Que., where he installed a new incandescent system.

Mr. J. Seguy, of Quebec, has invented an apparatus, one part of which is placed on the inside and the other on the outside of steam boilers in order to economize heating. It can be applied to all old boilers.

The Galt, Preston and Hespeler Railway Company have placed an order for an additional G.E. 1200 equipment with the Canadian General Electric Company.

A new electric railway company has been formed at Niagara Falls, Ont., composed of H. C. Symmes, R. Paine and others. It is proposed to construct a line which will connect with the Niagara Falls Park and River Railway and extend to Lundy's Lane battle ground.

The Consolidated Railway Company of Vancouver, B.C., have placed a large order for G.E. 1000 motors with the Canadian General Electric Company.

The 1,000 light standard alternator purchased by the corporation of Huntsville from the Canadian General Electric Company, was put in successful operation last week.

The town of Thorold has purchased the incandescent electric light system from Mr. McGill.

The Stadacona Water, Light and Power Company, of Huntingdon, P. Q., ordered a 60 k.w. 1,000 light standard alternator from the Canadian General Electric Company.

A new electric light company has been formed in Aylmer, Ont., to be known as the Aylmer Electric and Manufacturing Company, Ltd. The directors of the company are: Hugh McDiarmid, Daniel C. Davis, John Simpson, all of Aylmer, and Jos. W. Campbell and W. H. Irving of Toronto. Extensive improvements and additions are to be made to the present plant.

The Hamilton, Grimsby and Beamsville Railway Company have purchased G.E. 1,200 equipments from the Canadian General Electric Company for the improved freight and express services which they are about to commence. Their intention is to load C. P. R. express cars with fruit, along the line, and draw them over to the T. H. & B. road for carriage to Toronto and other points.

The Brockville Electric Light Company are making extensive improvements in their incandescent lighting plant. They have placed an order with the Canadian General Electric Company for a 100 k.w. monocyclic alternator of their new 125 cycle type. The use of 125 cycles in this case was rendered necessary by the fact that the old transformers, of which between three and four thousand lights capacity were installed, were unsuited for operation on a lower frequency.

Patents have recently been granted for Canada as follows: Canadian General Electric Co., Toronto, dynamo; Wm. Smith, Sheldon, Iowa, rotary steam engine; James and Emery Caldwell, Auburn, N. Y., turbine water wheel; E. J. Armstrong, Oswego, N. Y., crank disk for steam engines; C. P. Choquette and Antoine M. Morin, St. Hyacinthe, Que., acetylene generator; A. C. Fraser, Brooklyn, N. Y., process for generating acetylene; A. M. Scott, Hamilton, acetylene gas apparatus; John E. Friend, Lambton Quay, New Zealand, steam boiler; G. H. and M. G. Broder, Winchester, Ont., journal bearing; R. S. Hill, Detroit, valve for steam engine; General Electric Co., Schenectady, N. Y., electric brake; insulation of electric cable, Max Guillaume, Mulheim-on-the-Rhine, Germany; The Stilwell-Bierce & Smith-Vaile Co., Dayton, Ohio, electric water wheel governor; Bell Telephone Co., Montreal, multiple switchboard spring jack; Franz L. Barthelmes, Toronto, wood pulley.



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**6 TO 16 MORSE STREET
TORONTO**





The electric light company at Rat Portage, Ont., are putting in new generators for arc lighting and power.

The Hamilton Street Railway Company have placed an order for G.E. 1,200 motors with the Canadian General Electric Company.

The Canadian General Electric Company have furnished to additional G.E. 1000 motors to the Kingston, Portsmouth and Cataract Railway Company.

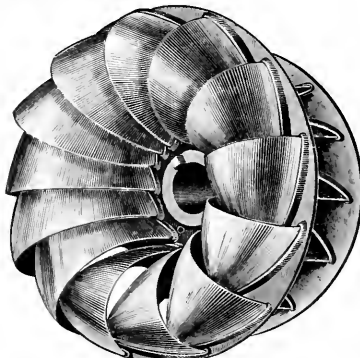
George White & Sons, Limited, London, Ont., are seeking incorporation as manufacturers of steam engines, boilers and other machinery, with a capital of \$170,000.

The Electrical Construction Company, of London, Ont., has been incorporated, to take over the business of the London Electric Motor Company. The capital stock is \$45,000.

F. E. Harvey, doing business as the Citizens Telephone Exchange, Waterloo, Que., is reported to have assigned, with liabilities of \$12,000. The estate will probably pay fifty cents on the dollar.

The Canada Permanent Loan and Savings Company have awarded the contract for a 500 light direct-connected incandescent plant, for the Clarendon Hotel in Winnipeg, to the Canadian General Electric Co.

WATER POWER CROCKER TURBINE



The above Engraving illustrates the Runner Removed from Case.

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VII.

JUNE, 1897

No. 6.

SARNIA GAS AND ELECTRIC LIGHT CO.

We print herewith an illustration of the power station of the above company, accompanied by a few particulars descriptive of the equipment of the same.

The building is of red brick, with freestone trimmings and stone foundation, with basement under the engine room, having truss roof covered with iron, making the building practically fireproof. The size of the structure is 34 x 72, with an octagon brick smoke stack 75 feet high. The foundations for engine, dynamos and line shafting are of stone and brick set in cement, reaching through the main floor.

The steam plant consists of a Wheelock engine 13 x 30, boiler 60" x 14', 84 3" flues, with all necessary shafting and pulleys, manufactured by the Goldie & McCulloch Co., of Galt.

The electric plant was built during the summer of

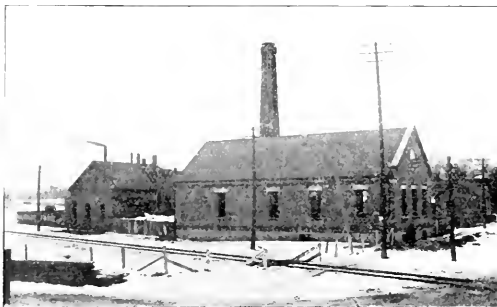
electrician. Accompanying this article are portraits of these two gentlemen.

QUESTIONS AND ANSWERS.

SUPERINTENDENT writes: "In a 2,080 volt monocyclic dynamo or in any other machine, does it not have a bad effect upon the armature to have the commutator short-circuited to a more or less extent? I claim that it not only has a bad effect upon the stationary shunt, but also upon the rotating shunt and armature. Am I right or not, please? Would the short-circuiting of the commutator cause the armature to finally burn up altogether? Another question—Supposing I carry on my 'secondaries' a voltage of 118 and then reduce it to 112 volts, what candle-power would I be getting from a 50 c. p. incandescent lamp? How is it computed? and is there any table or book published upon this ques-



Mr. Wm. Williams.



THE SARNIA GAS AND ELECTRIC WORKS.



Mr. Geo. Shand.

1894, and consists of one 75 light Wood arc dynamo with spare armature, a 30 kilowatt T.H. alternator with 1½ k.w. exciter, with the usual switchboard apparatus. The electrical plant was installed by the Canadian General Electric Company.

The arc line for public lighting required over 16 miles of No. 6 wire and ten miles of poles, feeding sixty-two 1200 c.p. lamps. Over 600 lamps are wired up for incandescent lighting in the town.

In order to further increase the capacity and efficiency of the plant, during the past summer a 300 h.p. Northey duplex condenser and a duplex boiler feed pump were installed, taking water supply from the river through an 8-in. pipe. These improvements add easily 25% to the economy and efficiency of the plant. It is contemplated to further increase the plant by adding an additional boiler and a larger alternator during the year.

Mr. Wm. Williams is the manager of the business, the success of which is largely due to his enterprise and good judgment. He has an able assistant in the person of Mr. Geo. Shand, the chief engineer and

tion? Are not electric wires apt to become "grounded" by passing through branches of trees, especially in constant wet weather? How could you tell if they were grounded if you had no ground detector? Could you tell by 'bell-tests'? How are series incandescent lamps connected up in connection with a direct current arc circuit? If you will be so kind as to answer these questions in your next issue, I will, I am sure, feel obliged."

ANSWER.—(1) In any generator the short-circuiting of the commutator, if a D.C. machine—or the collector rings, if an alternator—will result in a burnt armature. If the "commutator" in the above question means the two-part commutator used in the series field, then short-circuiting it will, in the first place, have the effect of (a) cutting out the compounding coils, leaving the machine as though it were merely separately excited; or (b) depending on the method of connecting in the two parts, might have the effect of sending an alternating current round the series coils; and in the second place would (a) cause heat, which might injure the armature. (2) Supposing your 50 c. p. lamp was intended to give that at 118 volts,

then reducing the pressure to 112 would probably reduce the c. p. to about 40 c.p. There is a theoretic method of calculating the reduction of candle power, depending on several specific quantities, such as resistance of filaments, specific incandescence, etc., which is too complicated; it is sometimes stated that variations of 1% in voltage cause variation of 5% in c.p. Ram's book on incandescent lamps is good. (3) Wires are liable to be grounded against branches. (4) A magnet bell will usually disclose the presence of a ground. (5) Just like arc lamps, in series.

A. S. P. writes: "Will you kindly give me some information on the Grant Bramble rotary steam engine, of Sleepy Eye City? I would like to know whether the wheel will rotate when steam is admitted into the chamber, as it is claimed it will."

ANSWER.—The engine will certainly rotate, but the mere fact of it doing this is no evidence of its becoming in any way a superior motive power. As a matter of fact there is not a single point in its favor that will recommend it to a practical engineer. Mr. Bramble has been getting a lot of fine advertising and has produced nothing that is in anyway useful to the engineering world—certainly not an economical rotary engine.

THE STEAM BOILERS ACT.

THE above is a title of a bill now before the Dominion parliament to provide for the examination of stationary engineers and the inspection of steam boilers, the promoters being the members of the Canadian and Ontario Associations of Stationary Engineers. It is improbable that the bill will pass the House at the present session but it is hoped to make such advancement as will ensure its success next year. Below are given the chief provisions of the act:

The Governor in Council may appoint a chief inspector of steam boilers and not fewer than eight inspectors for the purpose of carrying out the provisions of this act, and the said chief inspector and inspectors shall constitute a board to be known as the Board of Steam Boiler Inspection.

No person shall be appointed a member of the board who has not at least five years' experience as a practical engineer, and who does not hold a high class certificate from some incorporated body or government board, showing that he is a person possessed of practical knowledge of the structure and operation of steam boilers.

The inspectors shall meet under the direction of the chairman for the purpose of making regulations subject to the approval of the Governor in Council and not inconsistent with the provisions of this act:—(a) For holding annual or special examinations, to be conducted by the board or any member thereof, of persons from time to time applying under this act; (b) for granting certificates of qualification to persons passing such examination; (c) for regulating the manner of operating steam boilers and the methods to be adopted for securing the safety thereof; (d) for providing for the uniform inspection of steam boilers, the tests to be used on such inspection, and the circumstances under which such inspection shall be made.

Every person not duly registered under this act, who, after the day of one thousand eight hundred and ninety eight, operates any steam boiler, or is in charge of any steam boiler while in operation, whether as owner or as engineer, shall be liable, on summary conviction, to a penalty of not less than dollars and not more than dollars.

Every person who, at the date of the passing of this act, has been for two years engaged in the operation of steam boilers, upon producing a certificate of his uniform good conduct and sobriety from the owners by whom he has been employed during the said period, and also from some responsible person not connected with the business of such owners and a resident in the municipality or in each of the municipalities in which such boilers

have been so operated, or a holder of a certificate from any incorporated body or from any province, shall be entitled, upon making an application to the chairman of the board on or before the first day of January, 1897, and upon payment of dollars to the chairman, to receive a certificate of qualification and to be registered under the provisions of this act.

Any candidate who considers he has been unfairly dealt with by any of the inspectors, or whose certificate has been revoked, may appeal, in writing, to the chairman of the board, setting forth such grievance; and the chairman shall at once investigate such charge, calling in two of the inspectors to assist him; and their decision shall be final.

In case any owner of a steam boiler shows, to the satisfaction of the chairman, that he is unable, by reason of some unforeseen occurrence, to immediately secure the services of a duly qualified person to operate such boiler, the chairman or other inspector to whom such application is made may grant a permit to any person producing satisfactory evidence of good conduct and sobriety to operate such boiler for a period of sixty days from the date of application, and in such case no penalty shall be incurred by reason of operating such steam boiler pending the granting of such permit.

Every owner of a boiler shall cause it to be inspected at least once in each year by an inspector appointed under this act. The inspector making such inspection shall forward a copy of his record thereof to the chairman, who shall immediately forward a certificate of inspection to the owner. Such certificate shall be produced upon demand by the chairman or any inspector under this act. For such certificate the owner of the boiler shall pay a fee of dollars.

The provisions of this act respecting the inspection of boilers shall not apply to any boiler insured and inspected by any duly incorporated boiler insurance company doing business in Canada, but the owner of such boiler shall, when required by any inspector under the provisions of this act, produce the certificate of inspection from such company.

PERSONAL.

Mr. W. B. Close has succeeded Mr. R. H. Fraser as manager of the Toronto and Suburban Electric Railway.

Mr. M. J. Sullivan, for many years with the Great Northwestern Telegraph Company at Toronto, has accepted a responsible position in New York.

Mr. A. Smith, of Kingston, has been appointed district superintendent for the Bell Telephone Company for the territory lying between Kingston and Windsor.

Mr. F. C. Wanklyn, who lately became manager of the Toronto street railway, has been appointed superintendent of the Montreal street railway pro tem during the absence of Mr. Granville Cunningham in Birmingham, where the latter will assist Mr. James Ross in the conversion of the road there into an electric railway.

Before leaving for the mining districts of Northwestern Ontario, Mr. R. H. Fraser, manager of the Toronto & Suburban Electric Railway, was tendered a banquet at Occidental Hotel, Toronto Junction. After the banquet the street railway employees waited upon Mr. Fraser and presented him with a gold-headed cane, on which was inscribed, "To R. H. Fraser, Esq., by the employees of Toronto Suburban Street Railway, April 30, 1897."

Judgment has been given at Montreal maintaining the injunction of the Bell Telephone Company against that city. The City Council in November last passed a resolution instructing the city engineer to prevent the petitioner from opening the streets. The court holds that the charter of the Bell Telephone Company gives it the right to make the necessary excavations in the streets to lay its wires underground, and enjoins the city from interfering.

Messrs. Achille Gagnon & Co., of Victoriaville, Que., who began in December last furnishing incandescent light to the towns of Victoriaville and Arthabaskaville, have found it necessary to increase their plant, owing to the rapid increase of their lighting. They have placed their order for a 75 k.w. S. K. C. two-phase alternator with the Royal Electric Company of Montreal, as it is their intention to furnish power as well as light from the same generator and circuit. Their first installation was single-phase alternating, but finding that they could also secure some power business during the day, they decided to operate their plant 24 hours per day, and for this purpose secured an S. K. C. two-phase machine, from which they can serve both light and power from the same line.

CONVENTION SPARKS.

[From Souvenir Number ELECTRICAL NEWS, C.E.A. Convention.]

It was a case of "Put me off at Buffalo."

Did we hear you ask "where are we at?" At the end of three days of solid enjoyment.

What a good thing for the farmer hereabouts that the time is not yet, seeing that the lady bicyclist is abroad in the land.

Notwithstanding the plentiful supply of water in this neighborhood, last night's banquet was a "corker," or rather un-"corker."

To-day we shall have the privilege of seeing the biggest thing on earth in the way of electrical enterprise. The next time we come we hope to see a duplicate of it on this side of the river.

As the result of his vigilant observation since last convention, will Mr. Milne tell us what is the latest prank developed by electric light meters? We want, if possible, to be in a position to head them off.

How does this convention illustrate the fact that our holiday seasons differ from those of our cousins across the herring pond? Give it up? Because we hear Carroll-ing in June instead of December. See?

Have you observed a change in appearance of the rainbow at the Falls since this convention assembled? Seems as though Black and Browne are the predominating colors, before whose lustre the other tints are dim.

It is reported that Mr. A. B. Smith has intimated his willingness to prepare a paper for next convention on "How to Keep Sub-Aqueous Cables in Working Condition," based upon recent experience at Sarnia and elsewhere.

Glad to see some Blue-Noses amongst us on this auspicious occasion. They have set us an example of cosmopolitanism which we would do well to imitate. Who knows but we may ere long have a convention down by the sounding sea?

Was it but the whistling wind, or our fancy, or did we actually hear, wafted on the breeze from Queenston, the strains of

"A life on the ocean wave,
And a home on the rolling deep?"

Perhaps friend Kammerer might be prevailed upon to give DeCew to seekers after franchises regarding the means employed to smooth down the opposition humps on the backs of the Hamilton aldermen. Will Mr. Kammerer turn on the X rays.

The man who asked that the ladies be excluded from the banquet on the ground that the embarrassment occasioned by their presence would cause him to forget his speech, is asked to appear for sentence at the Ladies' Headquarters, Hotel Lafayette, City.

This looks like a case of bearding Acetylene Gas in its den. It is to be hoped that notwithstanding the combination of acetylene gas and other kinds of gas and electricity prevailing hereabouts at present, there will be no explosions. We look to Bro. Wickens to keep the safety valve properly adjusted.

So far as the visitors to this convention are concerned, the popularity of Wilfrid Laurier pales into shadowy insignificance beside that of Wilfred Phillips, the good-looking manager of the Niagara Falls Park and River Railway, to whose indefatigable efforts much of the success of the present occasion is due. In the language of the Montreal contingent, Vive le Wilfred!

You may all know by this time that there has been

"A chiel amang ye takin' notes,"

but you may not be aware that the camera fiend, in the person of "Joe" Wright, has been quietly on the lookout for snap-shots since this Convention began. I may possibly have the privilege later on of letting you

"See yersel's as ithers see ye."

Did you ever listen to Mr. J. J. Wright as he discourses upon the beauties of agricultural life in comparison with the job of the man who finds himself in charge of a big lighting and power station? If not,

there are flights of enthusiasm and oratory which you may yet enjoy. The experiences of the last few months are said to have perfected Mr. W.'s ability to prove the affirmative of the proposition that the farmer has a picnic without apparently being conscious of his advantages.

As Canadians we feel at liberty to express ourselves in language more emphatic than polite regarding some of the work of the American law makers. We don't always see eye to eye with the Yankee government, but of the individual Yankee we have the highest possible opinion. The manner in which the visitors to this convention have been treated by our friends across the gorge shows them to be out and out "white men." In fact we think so much of them that we hope to annex more and more of them individually in the future.

MECHANICAL ENGINEERS' ASSOCIATION.

The Mechanical Engineers' Association of the province of Quebec was organized as a separate body in the year 1894, before which time its members were associated with the Canadian Association of Stationary Engineers. The object of the association is not only to insure for its members benefits in case of sickness or



MR. E. F. VALIQUET.

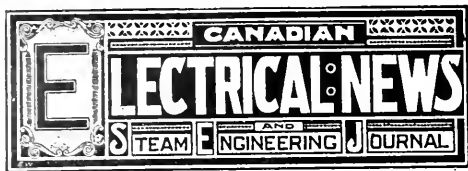
death, but also to give them the necessary technical instruction. Lectures are given semi-monthly by outside specialists, or by members of the union. By an intelligent administration this society, though having paid large sums of money to sick members, has to-day a good surplus. The election of its officers for the year 1897 took place on the 20th April, with the following result: President, E. F. Valiquet; 1st vice-president, H. Beauchamp; 2nd vice-president, M. Guimond; treasurer, W. Gendron; financial secretary, E. Leroyer; recording secretary, A. Belair; assist-



MR. H. BEAUCHAMP.

ant recording secretary, Jos. Gingras; corresponding secretary, A. Tessier; introducer, A. Habig; door-keeper, O. Fontaine; trustees, M. U. Lessard (president), E. Brisbois, A. Provost, J. Langevin, F. Lavigne, N. Despatie, Jos. Verdon; delegates to Central Council, E. Brisbois, M. Guimond; examiners, R. Drouin, E. F. Valiquet, H. Denis.

The new officers were installed on the 4th of May. Portraits of the president and vice-president appear herewith. The former is chief mechanical engineer at Rutherford & Sons' saw mills, which position he has occupied for the past five years.



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SUBSCRIPTIONS.

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Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address. The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. John Fox, President; Chas. Moseley Vice-President; T. Eversfield, Recording Secretary, University Crescent.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, John Murphy; 1st Vice-President, J. E. Huntington; 2nd Vice-President, Wm. Smyth; Secretary, B. Archibald York; Treasurer, Peter McNaughton.

ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Mont-real. R. Drouin, President; Alfred Latour, Secretary, 306 Deslisle street, St. Cuneoconde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in Macabee's Hall. Wm. Norris, President; E. Teeter, Vice-President; Jos. Ironside, Corresponding Secretary, Markland St.

STRATFORD BRANCH NO. 3.—John Hoy, President; Samuel H. Weir, Secretary.

BRANTFORD BRANCH NO. 4.—Meets 2nd and 4th Friday each month. J. B. Forsyth, President; Jos. Ogle, Vice-President; T. Pilgrim, Continental Corresponding Sec., Secretary.

LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. G. E. Risler, President; D. Campbell, Vice-President; Wm. Madden, Secretary-Treasurer, 537 Richmond street.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p. m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Sec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; T. G. Johnson, Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p. m. J. R. Utley, President; G. Stimmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p. m. President, F. Simmons; Vice-President, J. W. Tandy; Secretary, A. Macdonald.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. Pres. tent, Daniel Bennett; Vice-President, Joseph Lightball; Secretary, Percy C. Walker, Waterworks.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outhwaite, President; W. Foster, Vice-President; A. E. McCallum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, Archibald Franklin; Vice-President, John Grandy; Recording Secretary, James Atkins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

Canadian Electrical Association.

OUR readers will no doubt find much to interest them in the proceedings of the recent convention of the above Association, published in this number. It is gratifying to state that the attendance was satisfactory, and more thoroughly representative of the whole Dominion than on the occasion of any previous meeting. A large addition was made to the membership of the Association, principally from the ranks of central station owners and managers. The papers were quite up to the standard of former years, and covered a wide range of subjects. The discussions were far in advance of those at any previous convention both as regards the free expression of opinion and amount of practical information elicited. Central station practice properly received a large measure of consideration, and as a result many central station men were heard to express their appreciation of the benefits to be derived from connection with the Association and attendance at the convention. The reference in the president's address to the necessity of legislation for the protection of the rights of those who have invested their capital in the electric lighting business, and the subsequent action taken thereupon, indicate a determination to make the Association of practical value in conserving the interests of its members and of the electrical industries of the country. In this laudable endeavor it should receive the hearty support of all whose interests are bound up with these industries. The reelection of Mr. Yule was a fitting recognition of the zeal and success with which he has sought to promote the welfare of the organization, and under his guidance good results may be looked for in the year to come. It is to be regretted that Mr. L. B. McFarlane felt compelled, on account of pressure of other duties, to decline to again accept office in the Association. He has been a valued aid to the work of the Association in the past, and it is to be hoped may at a later date re-enter the harness. His successor, Mr. C. B. Hunt, is a gentleman of recognized business ability, and will be a source of much strength to the organization, while Mr. Kammerer, second vice-president, lacks neither the ability nor opportunity to enable him to advance its welfare. The executive committee comprises men of ability, and, we are pleased to say, is representative not only of Ontario and Quebec, but of the maritime provinces as well. In view of these and other favorable conditions, friends of the Association may reasonably look forward to a year of great prosperity and usefulness, culminating in a convention at Montreal in 1898 which will eclipse in interest even the successful event at Niagara Falls last week.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE SEVENTH CONVENTION, AT NIAGARA FALLS, ONT.



THE Seventh Annual Convention of the Canadian Electrical Association took place at the Dufferin Café, Niagara Falls, Ont., on the 2nd, 3rd and 4th of June, 1897. It was one of the most largely attended and interesting in the history of the Association. There was a noticeable increase in the attendance of central station men from various parts of the Dominion.

A meeting of the Executive Committee was held in the forenoon of the first day, at which twenty-five new members were elected. The first session opened at 2.30 o'clock, the President, Mr. John Yule in the chair.

There were present the following persons:

K. J. Dunstan	Toronto, Ont.
Frederic Nichols	"
J. J. Wright	"
C. H. Mortimer	"
Geo. A. Wilkie	"
E. K. M. Wedd	"
Irving H. Smith	"
A. A. Christie	"
A. B. Smith	"
J. A. Kammerer	"
W. A. Johnson	"
A. M. Wickens	"
W. J. Clarke	"
E. D. McCormick	"
W. H. Bourne	"
Albert Esling	"
T. F. Dryden	"
James Milne	"
F. H. Leonard, jr.	"
J. W. Campbell	"
Jos. Wright	"
E. B. Biggar	"
John C. Gardner	"
Ross McKenzie	"
John Yule	Guelph, Ont.
W. H. Browne	Montreal, Que.
John Carroll	"
Wm. Thompson	"
J. A. Bayliss	"
C. B. Hunt	London, Ont.
C. E. A. Carr	"
Capt. Williams	"
F. Pepler	Barrie, Ont.
Stephen Noxon	Ingersoll, Ont.
G. E. Gayfer	"
Henry Comstock	Brockville, Ont.
Geo. Shand	Samia, Ont.
Wm. Williams	"
John Murphy	Ottawa, Ont.
B. F. Reesor	Lindsay, Ont.
H. O. Fisk	Peterboro, Ont.
E. E. Cary	St. Catharines, Ont.
Geo. A. Powell	"
James Lamont	Chatham, Ont.
Geo. Phemister	Niagara Falls, Ont.
Wilfred Phillips	"
G. E. Foster	"
E. T. Freeman	Halifax, N. S.
V. B. Coleman	Port Hope, Ont.
John Farley	St. Thomas, Ont.
F. A. Bowman	New Glasgow, N. S.
J. W. Purcell	Walkerville, Ont.
W. H. Bullard	Seaford, Ont.
C. H. Philbrook	Buffalo, N. Y.
H. E. Adams	"
W. J. Johnston	New York, N. Y.
Wm. McCullough	"
Geo. Black	Hamilton, Ont.
W. F. McLaren	"
F. W. Martin	"
Gordon J. Henderson	"
B. J. Throop	"
Thos. Wadland	"
Q. C. Baker	"
Thos. Duncan	Fort Wayne, Ind.
C. J. Page	Welland, Ont.
J. M. Brown	Carleton Place, Ont.
Chas. E. Taylor	Sault Ste. Marie, Ont.

The President, after welcoming the members to the convention, read the following address:

PRESIDENT'S ADDRESS.

GENTLEMEN:—Once more the Canadian Electrical Association is convened for the transaction of business. Our place of meeting is at this particular time singularly appropriate, the whole district being an object lesson to those engaged in electrical enterprises. The progress of electrical science during the last few years is very fully exemplified in the various undertakings it will be our privilege and pleasure to examine during our meeting. I will, therefore, not take up your time with any remarks on the progress of development in the various branches of applied electricity.

The programme prepared will, I hope, meet with your approbation. The papers to be read are of interest to all, and the valuable information therein contained when carried home and put into practice will realize good financial results, and should be value for every dollar expended in attending this meeting.

Allow me to emphasize that this organization is not for the display of intellectual gymnastics, but to provide an occasion when all can meet on common ground and feel no hesitation in propounding questions or expressing views; every one is a member with equal privileges, entitled to and sure to receive respectful recognition. I therefore urge upon all to take an active part in the discussions. Surely in this gathering there can be culled sufficient information to repay every one of us for the time given to attend.

The different items mentioned in the programme for social enjoyment kindly provided by our friends here and on the other side of the river, will afford a treat not often enjoyed by us, and will, I trust, give members an opportunity of becoming better acquainted with one another. No business jealousies should find a place amongst us, rather ought we to help each other by exchanging opinions and experiences, and particularly should this be the case just now, when so many are face to face with that movement now prevalent in Canada for what is called municipal control. Many lighting companies during the past year have had to fight for the prevention of ruin to their enterprises. I, for one, can speak from personal experience. This question appears to me to be to lighting companies the question of the hour. Repeated repulses does not seem to stay the movement. It is gathering strength and some means will have to be devised to prevent the wiping out of a very large amount of capital legitimately invested in the electric lighting business. We look back and remember the inducements, encouragement and praise that were given to those venturing their savings in the business—in most cases done for the purpose of improving their town and helping their community to keep up with the march of progress—and compare therewith the now vehement attacks of local agitators, and even reputed respectable newspapers who din in the ears of the ratepayers the marvellous success and saving effected in a few large and rapidly growing cities in the old land, entirely oblivious to the conditions existing in the smaller cities, towns and villages of Canada. We hear of Glasgow, Manchester and Birmingham, where the civic ambition largely prevails amongst men of capital, leisure and ability, who give their time and talents to promote the common good. The late Governor-General of Canada, the Earl of Derby, is now serving as mayor of a large English city; while municipal affairs in Canada are managed in odd hours snatched from business, by men who cannot afford to give the time and attention necessary to the successful management of an intricate and hazardous mercantile concern like the supply of electricity. They also do not know or forget that municipal control was not introduced in England in the vicious way it is carried out in this land, by using the taxable resources of the ratepayers to ruin what was, at one time, by the same people, lauded as creditable enterprise on the part of their fellow citizens. It is not my purpose to enter into an elaborate argument why municipal control is not a success in Canada. The agitation is in the air and how best to save our property from complete confiscation is the question of primary importance. We do not dispute the right of municipalities to control and operate all their franchises, if honestly and fairly entered into. I hope that our Legislature will realize it to be their duty to provide for the compulsory purchase and transfer of properties where the local authorities decide to assume control of the lighting service, and prevent money invested by our citizens in necessary and laudable enterprises from being wantonly wasted. It is a hopeful sign that a few of our leading newspapers are now recognizing that the practice in some European countries of government control of monopolies is the true remedy for any evils that may exist. The Toronto Globe in dealing with the telephone question admits this principle in

pointing out the mistake that would be made, and the injury to the public which would follow, should a second telephone company be permitted to enter into business in Toronto. Quite recently the same paper quoted approvingly from a paper on "Monopolies and the People," where the author tersely sets forth the evils of the popular attitude towards competition projects:

"Let a proposition to build a competing railroad line or a competing electric light plant be submitted to popular approval and, under the impression that they are benefiting themselves, hard-working men will cheerfully assume heavy burdens of taxation to aid the new enterprise. So blind and unreasoning indeed is this popular abiding faith in the merits of competition, that it has been responsible for some of the greatest wastes of wealth in unproductive enterprises that have ever been known."

In Great Britain the government forbids by legislative enactments local authorities entering into competition with private companies, but makes it a necessary condition in their taking control of municipal franchises that all plant engaged in the business in their bounds shall be expropriated by the corporation and paid for, the value being arrived at either by mutual agreement or by arbitration. One would think from the discussions here that every municipal franchise in sight in Great Britain is operated by municipalities, but such is very far from being the case. I have not been able to procure all statistics, but will give you an example. In England, Scotland, Ireland and Wales, in the year 1895, there were 1318 gas undertakings operated by companies and only 165 managed by municipalities. This, in view of the fact that said municipalities could at any time expropriate these undertakings and operate them on their own account, does not denote the marvellous success our friends would have us believe, the power to expropriate having been in existence for nearly 50 years.

Electric lighting in Great Britain has not until within the last two years made very rapid progress. From all the information I can gather plants installed are a long way from being entirely under the control of municipalities. A good deal of adverse criticism followed the passing of the Electric Lighting Act by the parliament of Great Britain as being likely to retard the progress of the introduction of the supply of electricity there. Reading over the Act makes one think parliament, in their wealth of legislative experience, had in view just such a situation as exists in Canada to-day. The Act is very concise and provides fully for the method in which electric undertakings are to be started. Companies can be organized for this purpose, and on proving their good faith and ability to carry on the business, notice is given to the corporation, which has then a stated time within which to take up the business on municipal account. On their failing or not desiring to do so, what is called a provisional order is then issued by the Board of Trade (in England a department of the government) to the company, permitting them to operate within their district. This provisional order is about equal to our Act of Incorporation and gives a monopoly of the business under proper control. But what about street lighting? Are the municipalities required to pay any price demanded by the company for that service? Most decidedly not. Street lighting is carefully provided for in the Act. The company is compelled on a requisition from the local authorities to erect and supply street lights; the distances apart and other necessary conditions are prescribed in the general Act. Failing an agreement as to the value of the service, arbitration is resorted to for that purpose, the Board of Trade appointing the arbitrators. In fact, arbitration is the key to the whole situation. Every precaution is taken and provision made and no wilful destruction of property is allowed. I do not think I can do better than read to you the sections regulating the transfer from companies to local authorities as set forth in the Electric Lighting Act. It is not very long and will give you a fair idea of the method adopted. Sections 27 and 28 read as follows:—

ELECTRIC LIGHTING ACT.

Sec. 27. Where any undertakers are authorized by a provisional order or special act to supply electricity within any area, any local authority within whose jurisdiction such area or any part thereof is situated may, within six months after the expiration of a period of twenty-one years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special act, from the date of the passing of the act confirming such provisional order, or of such special act, and within six months after the expiration of every subsequent period of seven years, or such shorter period as is specified in that behalf in the application for the provisional order or in the special act, by notice in writing require such undertakers to sell, and thereupon such undertakers shall sell to them their undertaking, or so much of the same as is within such jurisdiction, upon terms of paying the then value of all lands, buildings, works, materials and plant of such undertakers suitable to and used by them for the purposes of their undertaking, within such jurisdiction, such value to be in case of difference determined by arbitration: Provided that the value of such lands, buildings, works, materials and plant shall be deemed to be their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, works, materials and plant, and to the state of repair thereof, and the suitability of the same to the purposes of the undertaking, and, where a part only of the

undertaking is purchased, to any loss occasioned by severance; but without any addition in respect of compulsory purchase or of good will or of any profit which may or might have been or be made from the undertaking, or of any similar considerations. The Board of Trade may determine any other questions which may arise in relation to such purchase, and may fix the date from which such purchase is to take effect, and from and after the date so fixed, or such other date as may be agreed upon between the parties, all lands, buildings, works, materials and plant so purchased as aforesaid shall vest in the local authority which has made the purchase, freed from any debts, mortgages, or similar obligations of such undertakers or attaching to the undertaking, and the powers of such undertakers in relation to the supply of electricity under this act or such provisional order or special act as aforesaid within such area or part thereof as aforesaid shall absolutely cease and determine, and shall vest in local authority aforesaid.

28. Where any matter is by this act, or any license, order, or special act directed to be determined by arbitration, such matter shall, except as otherwise expressly provided, be determined by an engineer or other fit person to be nominated as arbitrator by the Board of Trade, on the application of either party, and the expenses of the arbitration shall be borne and paid as the arbitrator directs.

Any license or provisional order granted under this act shall be deemed to be a special act within the meaning of the Board of Trade Arbitration, Etc., Act, 1874.

We also have an example on this continent of special legislation for controlling lighting companies. In the Commonwealth of Massachusetts there is a Board of Gas and Electric Light Commissioners appointed by the Governor and Council. This Board has been in existence for about thirteen years. The act establishing the Board sets forth that said Board shall have the general supervision of all corporations engaged in the sale of electric light and gas for lighting and fuel. I have been supplied with copies of the last three annual reports. From these reports it appears that nearly everything connected with lighting companies in Massachusetts, all relations between the companies, their customers and the municipal authorities are dealt with by the Commission. Applications for reduction in price, complaints as to the quality, giving power to increase capital, issue bonds, etc., are passed upon by that Board. What strikes me as very remarkable in dealing with the affairs of lighting companies is the unusual amount of common sense advice given to companies, corporations and customers. Their decisions furnish very interesting reading. The fair and equitable way they deal with all kinds of petitions would come to most of us in the nature of a surprise, our experiences are so different. Here is a quotation illustrating their methods. In giving their decision on a petition from the selectmen of Millbury praying for a reduction in the price and improvement in the quality of electric street lights, the commissioners say: "In reaching a decision the Board found it necessary to consider not only the street lights, but the company's income from its entire lighting business and the way in which its affairs are managed. Those who invest their money in order to render a public service of this character are entitled to a reasonable return from their business when properly conducted, but are not entitled for the sake of such return to impose upon a community additional burdens on account of careless or incompetent management." In this case the selectmen had offered \$2,000 for the service, the company asked \$2,500, and the Board decided that \$2,375 was a fair price.

Every lighting company in the state is required annually to make a return to the Board in a form prescribed by said Board of their financial statement for the year, giving full particulars as to capital, income, expenses, dividends paid, etc. It may interest you, gentlemen, to know that of companies doing a purely electric business in Massachusetts the table of dividends paid furnishes the following information: Report for 1895 gives 59 such companies, 35 of these paid no dividends, 2 paid less than 5 per cent., 22 paid 5 and over. In 1896 there were returns from 63 companies, 33 of these paid no dividends, 6 less than 5 per cent., and 25 paid 5 per cent. and over. In 1897 Report 62 companies are given: 31 paid no dividends, 9 less than 5 per cent., and 22 paid 5 per cent. and over. If this is the condition of electric lighting investments in a wealthy, thickly populated and prosperous manufacturing state like Massachusetts, I feel certain, could reliable statistics be obtained from the Canadian companies, an even worse showing would be made.

I have endeavored as briefly as possible to lay before you samples of legislation provided for the governing and regulating of capital invested in companies similar to those with which most of us are connected. The question that presents itself to my mind is: Have we not a right to claim the attention of the Legislature of Ontario (I mention Ontario because it is the storm centre of the present agitation), and present to them a request to pass legislation to meet the situation. Municipalities having invited citizens to invest their capital, persons who have taken the risk should be furnished with a reasonable and fair amount of protection. As the law at present stands opposition works can be started by corporations, and enterprising citizens taxed to support a concern competing with them and having the whole taxable resources of the ratepayers behind them. One would think that sound economy and common fairness should dictate a change in the present mode of regulating such investments.

The consolidation of the British and Massachusetts laws, would, I think, meet our conditions. I feel certain that a majority of the companies would be only too well pleased to transfer and take 75 per cent. of the money invested in their plant, should it be decided that municipalities desiring the control must first purchase existing plants.

My reason for thinking the Ontario government ought to look favorably upon our request is, that they have already acted upon and recognized the principle of transferring existing plants to municipalities where they wish to assume and manage semi-monopolistic franchise. In the Gas and Water Company's Act where power is given to cities, towns and villages to take possession of and pay for such plants, at present this power is permissive on the part of local authorities. It occurs to me, however, if corporations were compelled to purchase existing plants before going into business the movement would lose a good deal of the spice and zest it now has for agitators. Gentlemen, this is an important question, and I trust this meeting will be the beginning of an organization including every lighting company in Canada that will persevere until legislation is secured to prevent the making of no value the capital invested in good faith in the lighting business. Let us arouse from our lethargy and not lose sight of the fact that our very existence depends entirely upon the exertion of each and every individual interested.

Before passing from the subject permit me to say it is with pleasure I can testify that the leading manufacturers of apparatus in Canada cannot be charged with what I have noticed complained of in the United States. There it is stated that manufacturers of electric lighting machinery, finding the field for disposing of their products getting limited, are now giving their attention and for the sake of making sales, persuading municipalities to go into the business. We do not expect manufacturers will refuse to sell to municipalities when they wish to purchase; that would be unreasonable. But that they take a stand for the best interest of the business and do not lend themselves to helping in confiscating the property of those who had the courage to invest in electric lighting enterprises, is very much to be commended.

I cannot close my remarks without a feeling reference to the untimely death of our respected late 2nd Vice-President, Mr. E. Carl Breithaupt. I am sure I express the opinion of all who had the pleasure of knowing him that he was a young man of great promise in his adopted profession, and a genial and trusty friend. His death is a decided loss to our Association.

In conclusion I can safely affirm we all agree that those of our members who have taken the trouble and time to prepare papers for our meeting are deservedly entitled to our sincere thanks. In no way can we better show our appreciation of their efforts than by attending punctually at the hour of meeting, that they may have the inspiration of our presence. It is theirs by right of courtesy and I feel sure each member will concur in this and fulfil his individual responsibility and duty by punctual and regular attendance.

I desire to express my thanks for the distinguished honor you conferred upon me in electing me to preside over your deliberations at this meeting. I crave your indulgence for any shortcomings on my part.

At the close of his address the president was greeted with applause.

The President: Does the Association wish to take any action at this stage with regard to the recommendation contained in my address.

Mr. J. J. Wright: I would suggest that, as we expect a much larger attendance to-morrow, the matter of appointing a committee to take up this recommendation be allowed to stand until then, and in the meantime the members will have an opportunity to think it over.

Mr. C. B. Hunt: Mr. President, while I agree with Mr. Wright, do you not think it better to have a committee appointed now, so that a report can be made to this convention.

Mr. J. J. Wright: It is not necessary to make a report to this convention.

Mr. Hunt: I think the committee ought to report back to this convention, as we only meet once a year. With your permission I would like to name a committee to take up this matter, consisting of the following gentlemen: Messrs. Wm. Williams, S. Noxon, B. F. Reesor, J. J. Wright, J. Lamont, H. Comstock and the mover; and that this committee report back to the convention to-morrow.

Mr. J. J. Wright: I second the motion.

The president put the motion, and on a vote being taken, declared it carried.

Mr. C. H. Mcrtimer, secretary-treasurer, read the minutes of the last annual meeting, which on motion were adopted as read.

The secretary then read his report as secretary-treasurer for the past year, as follows:

SECRETARY-TREASURER'S REPORT.

MR. PRESIDENT AND GENTLEMEN:

It is a sincere pleasure to me, as I am sure it will also be to you, that the report which I am now called on to present is one of a very encouraging character.

As regards our membership, there have been added during the year 42 active members and two associates, a total of 44. During the same period 9 active and 5 associate members tendered their resignation; 6 active members were removed from the roll owing to having changed their addresses and the impossibility of learning their whereabouts; 33 active members and 14 associates, after having received due notice, were struck off the roll for non-payment of dues. The total number of names removed from the membership list during the year for the causes mentioned, was 62. In addition death has removed two of our members, the late Mr. E. Carl Breithaupt, who occupied the position of 2nd Vice-President, and Mr. A. W. Congdon. Their loss we deeply deplore. Our membership at this date comprises 154 active members and 19 associates—a total of 173.

As regards the large number of persons struck off the roll for non-payment of fees, I beg to quote as follows from my last report: "There are on the roll a large number of persons who, without having resigned their membership in the Association, have ceased to take an active interest in its affairs, and have likewise failed to pay their membership fees. It should be understood that when a person joins the Association, he thereby becomes a member, not for one year only, but until such time as he formally resigns his membership, and that until his formal resignation is received by the Secretary and accepted by the Executive Committee, he continues to be liable for payment of the annual fee. It is perhaps due to lack of a definite understanding on this point that the actual standing of the Association, with regard to its bona fide membership, is at the present time somewhat uncertain. The time has arrived when definite action should be taken to put an end to the present and future uncertainty with regard to this matter."

The Executive Committee several months ago decided that persons in arrears for fees, who had been carried forward on the roll from year to year, should be notified that their names would be struck off on the 1st of April if their dues were not previously paid. This decision was carried into effect. As a result, though there is an apparent decline in our membership as compared with last year, it has improved in quality, and is on a much more satisfactory footing than ever before.

The finances are in an equally gratifying condition. The receipts for the year show an increase of \$48.03 above those of the previous year, while the increase in disbursements was only \$165.86, leaving a net gain of \$282.17.

Meetings of the Executive Committee were held on July 24th, 1896, Feb. 25th and April 12th, 1897.

At the first of these meetings the accounts in connection with the last convention were passed and ordered to be paid, two associate members were elected and the resignations of six members accepted.

At the meeting in February a resolution of condolence with the family of the late Mr. E. Carl Breithaupt was passed and the Secretary instructed to draft and present the same. The Secretary was instructed to notify members in arrears for fees for a longer period than two years that unless the sum of their indebtedness was paid prior to the 1st of April their names would be erased from the membership roll. The Secretary was further instructed to send accounts for fees to members in arrears for the current year, and give notice that draft would be made if the amounts were not paid within 10 days. Mr. Higman, of Ottawa, was elected a member of the Executive Committee, and Mr. Chas. Hunt was elected 2nd Vice-President to fill the vacancy caused by the death of Mr. Breithaupt. The dates were fixed for the present convention and committees appointed to make the necessary arrangements. Three active members were elected, several accounts passed and ordered to be paid.

At the April meeting five persons were elected to active membership; the sum of \$175 was ordered to be placed to the credit of the Banquet Committee.

Following is a detailed statement of the receipts and expenditures:

RECEIPTS.

Cash in bank June 1st, 1896.....	\$157 21
Cash on hand June 1st, 1896.....	1 50
107 active members' fees at \$3.00.....	501 00
1 active member's fee at \$5.00.....	5 00
20 associate members' fees at \$2.00.....	58 00
Cash for exchange on cheque.....	15
25 copies of report of Sixth Convention sold.....	2 50
Cash from local electrical companies towards entertainment expenses.....	100 00
Refund from Statistical Committee.....	25 00

\$430 36

DISBURSEMENTS.

Expenses of convention at Toronto	\$352 47
By cash: C. V. Ward's account, Lorne Park	\$106 00
C. V. Ward toward floral decorations	10 00
Sir. Greyhound account	20 50
J. Ball, music	10 00
Board of Trade, rent	14 00
Caretaker, Board of Trade	3 00
Elevator man, Board of Trade	2 00
S. Tidy's account	1 50
Alexander & Cable's account	5 00
Monetary Times account	24 00
"Electrical News" account	79 25
Canadian Photo-Engraving Co.'s account	28 00
Geo. Angus, stenographer	40 00
Ribbon and pins for badges	2 88
Express charges	25
	\$352 47
Grant to Secretary	75 00
Stationery	1 90
"Electrical News" printing	33 00
Telegrams	1 30
Telephone messages	60
Postage	62 32
Exchange on drafts and cheques	7 95
Cash in bank May 31st, 1897	410 57
Cash in hand May 31st, 1897	5 25
	\$940 36

The report was adopted as read, on motion of Mr. J. Carroll, seconded by Mr. E. E. Cary.

REPORTS OF COMMITTEES.

Mr. J. J. Wright, on behalf of the Committee on Legislation, reported as follows: It has not been found necessary during the past year to convene the committee; there was no legislation that affected the interests of the members generally, and any little matters which came up in the House of a local character were attended to by those personally interested. There is also another committee for which I imagine I am responsible in a way, and that is the committee to interview the government on the question of meters. Nothing has been done in that connection, especially after the discussion we had on that question at the last convention. We found that the officials of the government were disposed to meet us in every reasonable way and treated us very fairly, and there was no urgent necessity under the circumstances to have an interview with the government. But I think both in the question of legislation and also in regard to the question of government inspection of meters, it would be well to exercise considerable care in selecting a committee, for the coming year bids fair to be an important year in both branches.

The President: The late Mr. Breithaupt was chairman of the Committee on Statistics, and I was next on the list to him, but I have not as yet been able to get possession of the papers from Mr. Breithaupt's executors. I have applied for them, but they have not come to hand.

Mr. J. J. Wright: Do you think, Mr. President, those papers will be available; I understand that Mr. Breithaupt devoted considerable time to that committee before his death, and if those papers can be made available, they will be quite a help to any new committee that may be appointed?

The President: The papers are in existence, because I had quite a large number of them during our campaign in Guelph. I sent them back to Mr. Breithaupt, and I think I will be able to get them.

The President: I will name Mr. B. F. Reesor, Mr. C. B. Hunt, and Mr. A. B. Smith as a committee to name the standing committees.

GENERAL BUSINESS.

Mr. C. B. Hunt: I do not know whether there are many of the members who know of the new order that has been issued in Council in regard to the inspection of meters; it is one of very great importance to most of us, and I think there ought to be some discussion on it, either to-day or to-morrow. The matter is simply this, that the charge for the inspection of meters now is made per lamp instead of per ampere. To those of us who have a 106-volt service or a 110-volt service the rating for inspection is very much increased. I might give

you an example: Take, for instance, a 10 ampere meter that we used to pay 75 cents for, the rating is now \$1.25; on a 15 ampere meter it is increased from \$1.25 to \$1.75; on a 25 ampere meter it is increased from \$1.75 to \$2.25; on a 50 ampere meter it is increased from \$2.25 to \$3.50; on a 100 ampere meter it is increased from \$3.50 to \$5.50, and on a 150 ampere meter it is increased from \$4.25 to \$7.50. If you happen to have three wire meters it will be pretty nearly doubled on that again. I think, therefore, it is necessary to have some discussion on it before we adjourn the convention.

Mr. J. J. Wright: I would move that we make a present to the government of the whole of our plant. (Laughter).

Mr. Hunt: They will have it soon.

The President: You had better bring the matter up to-morrow. As there is nothing else at present under the head of general business, we will call on Mr. John Murphy, of Ottawa, to read his paper entitled "Water Driven Plants."

Mr. Murphy then read his paper, which appears on page 123.

The President: I might say that we have water power some seasons of the year; most seasons we have not. The most satisfactory regulation I find is a quick-acting engine on the same shaft with the water wheel. That has been my experience in regulating when running with water power. The governors that we got did not seem to act quick enough, and the lights were not at all satisfactory. So we put the engine on the same shaft and governed with it.

Mr. H. O. Fisk: Mr. President, we regulate about the same way as you do, although we have one water power generator with an automatic regulator, which works very well; it may lose 10 or 15 volts, perhaps, with a very sudden change of load; it never exceeds that. In our incandescent lighting we regulate it by hand, and just increase the power as the load comes on, and take it off accordingly. It works very well.

Mr. B. F. Reesor: I have had no experience with regard to driving electric plant with a water wheel—we drive ours with an engine, but I have had considerable experience in water wheels, and I can quite understand where a water wheel is taxed to almost its utmost capacity it would vary very much. But the same thing holds good with an engine or water wheel, and much more so with a water wheel; it will pull it down very much in putting on a considerable load. A good plan is to have any amount of power to spare. The throwing on of an ordinary load will not affect a water wheel so much by having a governor, but where the wheel is taxed to almost its capacity I can see the difficulty that no governor will help very much to overcome the pull down for electric incandescent lighting.

Mr. Fisk: In regard to governors for street railway work: I suppose that is about the hardest kind of work we have to deal with. We found down in Peterboro' that it was impossible to get a wheel that would stand governing for any length of time; the pinions and everything wear right out with the constant rocking backwards and forwards. We simply had to abandon it, and I believe for that reason that the apparatus that provides a constant load for a generator would perhaps be the best in the end. We had a couple of wheels revolving on balls, and the balls actually cut right into the iron, so that the thing came right down and ground away there, and would not work. We had no end of trouble till we took our governor off, and I have since thought that perhaps the best way is to keep a constant load on the machine if it is possible. I believe there is an apparatus working up here at the Niagara Falls power house now that keeps a constant load on the generator all the time; when the load is not on the road it is on the resistance.

Mr. S. Noxon: I do not know whether I am presumptuous in offering to say a word, seeing I am not interested in a water power plant, but I have had considerable experience in the use of water power. I lived for a time in Walkerton, and we had a large water

power there which we employed to drive two or three mills. I took considerable interest in the matter of the regulation of water wheels, and came to the conclusion from the experiments made there that it was impossible to regulate a water wheel running at a slow speed, under a comparatively low head. The feed of the water being so sluggish in its action, it was impossible to get any close regulation by any governor; the governor might work quickly but the wheel would not. It wasn't any trouble to get a governor to operate the gate, but the trouble was to get the wheel to respond quickly enough. I have seen governors applied to water wheels under a very high head which regulated very closely, but that is the only condition under which I believe the governor can be applied to a water wheel to give anything like a close regulation. It can be done there because the wheel runs altogether with the impact of the water, and as soon as the water is shut off a little the wheel responds. I think that is about the only condition under which a regulator will work upon a water wheel with any degree of satisfaction.

Mr. A. B. Smith moved, seconded by Mr. A. M. Wickens, that a hearty vote of thanks be tendered Mr. Murphy for his interesting paper. Carried.

The President: I will now call on Mr. Wickens to read his paper entitled "The Steam End of an Electric Plant" (see page 123). It may come in very profitably after having just had the water end.

Mr. Wickens then read his paper.

Mr. J. Milne: There appears to be a little mistake in the second paragraph. If you look at the paper it says: "Our steam engine is only a heat engine, and is subject to many losses, in fact, in some of the old engines with large cylinders and slow piston speeds, the water consumption was as high as 60 lbs. per hour per h.p., while to-day, with our higher boiler pressures and faster piston speeds with early cut-offs, we reduce that to two and one-half pounds water per h.p. per hour."

Mr. Wickens: That is intended to have been 12½ pounds.

Mr. Milne: It says a little further down: "This very high pressure at that time was only expanded eight-fold, and even under such circumstances gave a h.p. for about two pounds of water per hour." I presume that should be "12" again.

Mr. Wickens: Yes.

Mr. J. J. Wright: There must be some discrepancy here, because you are comparing a modern expansive plant with the experiments of Mr. Perkins, which were manifestly not up to date.

Mr. Wickens: With regard to the engine at Sibley College, there have been a great many reports sent out about it; they were using steam at 500 lbs. pressure; it was an experimental engine built to see what they could do. They undoubtedly have been getting a h.p. with 10 lbs. of water. What the evaporation of the boiler was I don't know exactly; they simply gave the result of the use of the steam in the engine; if the evaporation was 10 lbs. of water per lb. of coal, they were getting a h.p. for one pound of coal per hour. There is no question they have got an exceptionally and remarkably cheap running engine. The point is where to stop putting in cylinders to save money. A short time ago a triple expansion engine was built in such a way that the intermediate cylinder could be discarded; this was a Wheelock engine, and upon experiments they found they had just as much economy without the intermediate cylinder as they had with it that the friction and loss in connection with that intermediate cylinder, under certain conditions of load, counterbalanced the efficiency of it. There were certain loads under which the engine was run in which the cylinder was all right.

Mr. Milne: There appears to be a little exaggeration about the middle of page 6 of the paper, where Mr. Wickens makes the quotation from the paper read before the British Institute of Civil Engineers, as follows: "Thus an expenditure of 5, 10 and 15 % of the furnace heat to super-heat gave a net gain of 12, 28 and 70% respectively of the work done for the heat supplied." I would take that to mean that by superheating the steam

up to that temperature you got 70 % more work out of the engine.

Mr. Wickens: No; there is simply an increase of seventy per cent. in the thermal efficiency; it is not so much the work done at the engine.

Mr. Milne: I am inclined to think that superheating is not what it is cracked up to be, because in the tests made by superheating there is very little gain in economy shown. In fact, where an engine is properly designed you can scarcely measure the amount gained by steam jacketing. A steam jacket is a good thing on what we might call a poorly-designed engine, but the amount of gain that can be got out of an engine with the cylinders jacketed does not exceed five per cent. at the very outside. This is a big saving in some places where they have large units, but in smaller units the saving would be a minus quantity. Sometimes we think because an engine is steam jacketed and so on, that we are going to get extremely high results in economy, but I think if the tests are properly conducted and everything measured properly that there will be very little saving. In designing engines there is one thing that has to be taken into consideration, and that is to make the difference of temperature between the initial pressure and the final pressure as small as possible so as to prevent condensation; the greater the difference the greater the condensation, and steam jacketing in a case of that kind may help a little, but where you have triple expansion I do not see that steam jacketing is of any use whatever. Of course, in taking in the gain of steam jacketing you have got to take into consideration the amount of steam spent in steam jacketing.

Mr. Wickens: I think what Mr. Milne says only bears out this very idea in my paper. I think he is right as far as he goes with regard to steam jacketed cylinders. We all understand that the affinity that heat has for iron is very great, and one of the strong reasons we are running a high speed engine to-day is because the ends of the cylinder do not get time to cool, and the incoming steam has not got to heat a lot of iron before it does any work. Take a slow speed engine, and when you open a steam valve at one end of the cylinder the first work that the incoming steam does is to re-heat the metal up to the heat it was when the steam was admitted at the previous stroke, and this is the first expense on the steam. This thing must have been recognized by engineers since the commencement, because the whole trend has been to stop it. Now, with regard to super-heating steam, when you get the steam super-heated and get enough heat in the steam so that when you release it, it has lost so little that the iron has nearly the same heat as the incoming steam, you will get over the very loss that they tried to save by steam jacketing these cylinders, provided you can carry the heat through to the end of the stroke. As I said in the paper, some thirty years ago most important experiments were carried on in the United States Navy on the use of super-heated steam; they discarded it because they could not keep the super-heaters tight and could not lubricate. To-day they have got rid of all that trouble; they can both keep the super-heater tight and lubricate the parts of the engine inside with the heat as high as 650 or 670 degrees. The particular things that stopped them in the early times have been overcome; and it seems to me to be a matter of experimenting before we can expect very much reduction in the use of coal by means of super-heating the steam.

Mr. Milne: There are slow-speed engines running to-day without a super-heater showing better results than many of the fast-running engines, so it appears to me there is a discrepancy some way or other.

Mr. Wright: I don't think you save anything in the loss of heat by the rapidity of the action of the engine. No matter how fast the steam is admitted, expanded and exhausted from the cylinder it will make no difference; if the vibrations are very rapid it doesn't give time for the iron to take up the heat. Of course, there will be a general average. It is just exactly as though you have a steam gauge on a cylinder where the pressure is fluctuating—you cannot possibly get at it. The gauge

cannot go fast enough, but if you take and choke that off you get the general average of that heat no matter how fast the engine is running, or whether the engine is running very slowly or very rapidly.

Mr. B. F. Reesor: A little further down in this paper I see Mr. Wickens says, in reference to keeping boilers clean, that some require caustic soda, etc. Nearly all the boiler compound men that come around say in the preparations they have got there is no caustic soda to keep the boiler clean. Then he says, "All organic matter needs alum or tassic." I would like to know how Mr. Wickens administers the "physic." (Laughter.)

Mr. Wickens: That is a misprint; it should be "ferrie acid." If you put a compound into a boiler you are simply giving it physic.

Mr. Fisk: What is the objection, if any, to using caustic soda.

Mr. Wickens: I would state, as far as my knowledge of using caustic soda for boilers goes, that the trouble is, it makes the steam so sharp that it cuts the valve faces, and more especially it will injure brass valve seats. A certain portion of it goes off in the steam.

Mr. Fisk: Does it go off in dry steam?

Mr. Wickens: Oh, yes.

Mr. J. J. Wright: There is a simple way of getting over the difficulty, that is, to give the boiler a dose of caustic soda and close it up, when it is not running, and then blow that out. That is the way we use caustic soda in our boilers. We let it stand there in the boiler without using the steam at all, and then wash out the boiler and go ahead.

Mr. C. B. Hunt: How much caustic soda per horse power would you put in, Mr. Wright?

Mr. Wright: We never figure it that way at all. The engineer simply says, this boiler is almighty dirty, and he would put in perhaps ten pounds of caustic soda. We find the same difficulty that Mr. Wickens speaks of if we put in a small quantity of caustic soda. It is, I think, the quickest scale remover that there is. We put in caustic soda in the boiler, and we found eventually the brass seats of the valves would show deterioration and a cutting of the faces, and we laid it down at once to the caustic soda and stopped using it, except in the way I have stated.

Mr. B. F. Reesor: Is there any gentleman here who is using petroleum?

Mr. Wickens: Having spent a few years in boiler inspection, it is a matter that I have had some opportunity of knowing something about. There are places where it is perfectly safe to use crude oil, and where crude oil will stop all scale forming in the boiler. There are other places where it will do to use kerosene and where it will work perfectly well; but any of these things are dangerous to be used generally, because they will not work with some of the chemicals or natural properties that are in the water. As soon as the oil deposits, you get the bottom of your boiler into trouble. I have seen many instances where men have used coal oil or crude oil and thought they had found something that was going to keep them out of trouble, but by the time they were using it five or six months they found they had to put new bottoms in their boilers. Pretty soon the bottom of the boiler gets in such a shape that it begins to leak at the joints and a new bottom has to be put in. There are a few places where it is perfectly safe, where it will not form and go to the bottom with the ingredients that are in the water; in that case it is pretty safe to use oil.

Mr. J. J. Wright: I think those remarks apply more particularly to crude oil. The way to get over that is simply to use refined oil instead of using the crude oil; it is a very good scale remover, putting it in by degrees. There is one precaution that must be taken, and it is a very important one—when the engineer has blown off his boiler and undertakes to put a lantern in to see how clean it is, he is liable to climb the stairs pretty quickly. There have been a number of explosions from that very cause.

Mr. Wickens: There are some of the creek waters that it can be used in, but when we come to using Lake

Ontario or large tributary waters, we usually have trouble with oil in any shape.

Mr. C. B. Hunt: What is your idea as to the cause of the crystallization of the iron plates where sometimes oil and sometimes caustic soda has been used?

Mr. Wickens: I think the crystallization is usually caused from overheating. It can be traced every time to overheating. As I state in my paper, as soon as you heat your iron up to 600 degrees and over, you are beginning to make it take a crystallized form. I am satisfied in my own mind when you get a crystallized boiler it has been overheated.

Mr. Wright: The crystallization may be due to other causes, for instance, the strain on the boiler. By the raising and lowering of the steam pressure perhaps many thousand times a day, a sheet may be changed in shape, as well as by overheating; and also again in the operation of a large number of boilers together, you often find there is a strong and steady vibration in the boilers themselves. By placing your hand against them you feel a very strong vibration that is set up in the construction of the boiler, and is the cause, no doubt, of crystallization. But I should think the main cause—I have always looked at it in that light—was the increase and decrease in the strain of the boilers, changing so slowly as not to be measurable, perhaps, the shape of the plates in the boiler.

Mr. W. Williams: We have tried various compounds in our boilers, and we find coal oil is the best; it is the only thing that will keep our boilers clean. We use Lake Huron water.

Mr. G. Shand: We use a quart a week and pump it in; our boiler is about 100 h.p. We feed it in gradually just before we shut down.

Mr. Yule: So that it doesn't go off in steam.

Mr. Shand: No. We blow it off.

Mr. Hunt: Do you have any foaming from that?

Mr. Shand: No.

Mr. Reesor: Where is your plant located?

Mr. Shand: Sarnia. We do not get a perfectly clean boiler with the coal oil, but we get it clean enough to suit. You can take a scraper and scrape off the loose scale.

Mr. C. B. Hunt: We had a little experience in our railway power house in London. The water we use is taken out of the river, and just above us are the gas works and also several city sewers, so we get "nice clean water." However, more or less of the scum from the gas works, in the shape of tar, etc., comes flowing down with the water, but there was some trouble with it, as Mr. Wickens stated; it formed a small amount of scale. We had to get a cold chisel and go right along and scrape it off. It wasn't as thick as a sheet of paper, but it was sufficient to cause one of the boilers to bulge down.

Mr. Wickens: I have seen the same thing occur with the use of coal oil in boilers.

Mr. Hunt: It is a sort of drainage from the gas works.

Mr. Wickens: I had the same thing occur in Belleville. They got along splendidly for a few months, but then they found a scale on the bottom.

Mr. B. F. Reesor: What would Mr. Wickens recommend for water that contains carbonic acid gas and oxygen that causes the tubes to pit very rapidly?

Mr. Wickens: Any kind of a pulp; take the Eucalyptus leaf, which makes a jelly, or any good kind of gelatine that is heavy enough to stay down. If you break one of those pits you will find there is a little black, wet, slimy centre to it, and if you test it you will find it is acid. There is no question in my mind but that any of those particular jelly-forming plants will answer the purpose. Irish moss will do if it is properly cooked down, but the most efficient I have heard of is the reducing of the Eucalyptus leaf into a jelly.

Mr. Reesor: Do you think the Balm of Gilead gum would do as well as the Eucalyptus?

Mr. Wickens: I don't know; it might. I never saw it tried.

Mr. Noxon: I am connected with an institution that has three large boilers. We are using water from the

river Thames; the water is very strongly impregnated with lime, and we have difficulty with lime scale. We tried all kinds of things, and the only plan we could adopt was to use caustic soda. We would put in a quantity of the soda and heat it up to the boiling point and let the boiler stand two days, and then heat it up again with sufficient pressure to blow it off. In that way we could keep our boilers very clean and without any detriment to the valves or brasswork of the engine.

Mr. Wickens: By using it that way you must use considerable. You have got to make it strong enough to take the scale right down.

Mr. Noxon: You require an extra boiler always.

Mr. Hunt: I have great pleasure in moving a vote of thanks to Mr. Wickens for his interesting paper. It is certainly one which every electric light manager or dealer is interested in. I know I am myself.

Mr. Wright: I second that.

The President put the motion, which was unanimously carried.

The convention then adjourned, to meet at nine o'clock on the following day.

In the evening a visit was made to Buffalo, where an inspection was made of some of the interesting electrical features of that city.

SECOND DAY.

The President called the convention to order at 9.00 o'clock.

A telegram was read from Mr. O. Higman, from Vancouver, regretting his inability to be present, and sending greetings to the Association, and wishing it continued prosperity, stating that he would still take an interest and help forward the work of the Association.

A telegram was also read from Mr. L. B. McFarlane, regretting his inability to be present.

Mr. B. F. Reesor, on behalf of the special committee appointed to name the standing committees, reported as follows:

Committee on Statistics: Messrs. A. B. Smith, A. M. Wickens, and O. Higman.

Committee on Meter Inspection: Messrs. J. J. Wright, Berkeley Powell, and James Milne.

Committee on Legislation: Messrs. John Yule, B. F. Reesor, J. J. Wright, John Farley, W. H. Comstock, C. B. Hunt, S. J. Parker, and F. Pepler.

On motion of Mr. B. F. Reesor, seconded by A. B. Smith, the report of the special committee was adopted.

The President: The next thing will be the report of the special committee on the recommendation contained in the president's address.

Mr. W. H. Comstock: As chairman of the committee appointed by this Association, I beg to report that it was considered absolutely necessary that the Committee on Legislation appointed by this Association for the ensuing year be asked to take this matter up, with power to act in raising money for that purpose. I will put in the resolution of the committee of yesterday.

Mr. F. C. Armstrong moved, seconded by Mr. B. F. Reesor, that the report be adopted by the Association. Carried.

Mr. J. A. Kammerer read his paper entitled "Day Loads for Central Stations, and How to Increase them," (see page 124).

Mr. J. J. Wright: It seems to me that this involves a question that was touched upon by Mr. Murphy in his paper yesterday. As I understand it, the idea involved in this paper is the running of arc, incandescent lighting and power from the same dynamo. Mr. Murphy did not seem to recommend that, and he is a gentleman who has had some experience, and I am going to bring this matter up simply to give the friends of alternating current apparatus, and especially to give the writer of the paper, an opportunity to still further substantiate his claim. I remember when I was a little fellow, and that was some time ago, seeing a conjuror who poured out three different kinds of wine out of one bottle; I thought it was a very wonderful thing at that time, but since then I found out it was a fake bottle—it wasn't exactly genuine. I am very far from saying that in this case the dynamo that will produce

all these things and do it as successfully as the fellow poured out his three different wines from the one bottle, is anything of that nature. It seems to me that those who have had experience in running incandescent lighting from the same generator as the motive power circuits have experienced a considerable amount of difficulty heretofore. If there is anything in the electrical field that is going to give us an opportunity of doing this just as smoothly and slickly as the gentleman I speak of poured out his wine, we ought to know it, as central station men.

Mr. W. H. Browne: Mr. Wright has put forward a problem that requires some consideration. I thought he was going to talk in a "right" manner; I thought he was going to speak from experience. As I understand it, he has two separate services in Toronto, one serving power, for which he requires a separate set of dynamos and a separate set of stations, and another plant for his lighting; and I thought he knew something about the fact that that was not a fake dynamo out of which you could get four or five different kinds of "wine," but as a matter of fact that you could run an incandescent lamp, an arc lamp and a motor from the same dynamo and the same wire; but, as he seems to be uncertain about it, and seems to have forgotten some of the things that have been told him, I will tell him something. I presume it is tolerably well known that we have reconstructed our incandescent station and are now operating five dynamos instead of thirty. We have a direct current power service in Montreal; we have an arc lamp service and an arc lamp station. We also have what we call our incandescent station. We have diminished our arc lamp commercial circuit from 350 or 400 private commercial arc light customers to about 125. We have a direct current power service which we have not diminished in any way, but we are serving customers every day with alternating current power service, and our commercial arc service has been diminished by the replacement of alternating arc lamps, so that we have from the same dynamo, the same boiler, the same engine, and the same building, a service of incandescent light, arc lamps and power. That brings up the question that I think Mr. Kammerer's paper directly refers to—the question of a day load and how to get it. We are serving power upon a meter price system; we are asking our customers to pay us for the current they actually use, and not undertaking to serve a flat rate. We have a flat rate price, however, in the nature of a fixed or minimum charge, by which we expect to be repaid the amount of money we have invested, and we make our prices for say 10 h. p. a certain fixed sum, small, but enough to cover our investment, and we are getting, on that line, nearly as much power service as we can take care of, and not at very low prices either. We are doing this in anticipation of a water power service, and the expectation of having low prices on that account. But at the present time we are keeping up the old motor prices as a basis, and we find the customers perfectly willing to give it. We are serving power from the same wire as the incandescent lights, and we find no difficulty; so that the conjure of this fake bottle has disappeared.

Mr. J. J. Wright: I hope the gentlemen present, Mr. Browne in particular, did not understand me as saying this thing could not be done. I am perfectly well aware you can produce arc lights, incandescent lights and motive power from the same service. But the question in the case of our friend with the bottle is that, although he did it, was it a practical operation? I know you can do all this; Mr. Browne is doing it in Montreal. It can be done. But can it be done as a practical and satisfactory operation? Mr. Murphy says he does not think so. From what experience I have had myself, I question whether it is altogether feasible, and I simply brought the question up, not because I know it cannot be done, but I want some of these gentlemen here who are doing this thing to give some of their experience as to how successful it is when it is done. For instance, you have a load, with these different services on the one dynamo; supposing you have a number of incandescent lights, and at certain times during the day there are not very many of these lights on;

some of the motors take a sudden draught of current and it interferes with the steadiness of the incandescent lighting. In Toronto we have our services on entirely different wires, and I would dearly love to get them all on the same machines. Being on separate circuits, I have not met with the difficulties that I have heard other gentlemen speak of in this matter, and that is the reason why I would like to hear something from those who have tried this, as to its practicability, that is, the steady running of incandescent lighting at the same time that you are making constant draughts on the same dynamo for motor power.

Mr. Murphy: With your permission, Mr. President, I will read the paragraph from my paper to which Mr. Wright refers: "Although one of the chief inducements which manufacturers hold out to intending operators of electrical plants is, that the multiphase system permits both light and power to be obtained from the same generator, yet I hold it is a mistake to attempt to supply power from a lighting circuit except in small units. Incandescent light and power should, I feel certain, never be run from the same water wheel." It is the trouble experienced in the regulation of the speed of the machinery, not of the dynamo itself, to which I refer. I think that is plain from the paragraph.

Mr. Fisk: We are not running power and lighting from the same machine to any great extent, but a few small motors do not seem to make any difference.

Mr. Milne: I do not think there can be any doubt on the subject whatever regarding the supply of light and power from the same circuit; it is unsatisfactory, especially where you have a large amount of power to supply. Take it in Toronto, where we have such a lot of motors and one thing and another requiring heavy powers, and it is impossible, no matter what the machine is like, to have perfect regulation. Take, for instance, the Edison three-wire system, where an electric elevator is turned on taking two or three hundred amperes to start with. I defy any system to have a perfectly steady light when we have a load of that kind, and it will be all the worse, I am certain, when the load is less. The variation during a maximum load is very small, but where you have a very small load the variation is considerable; even in turning on a six to twelve h.p. motor you are sure to notice a wink in the light, whether that is caused by trouble in the generator or engine. Suppose it is in the engine, then the trouble is just going to happen as readily with the multiphase as with a continuous system; if the trouble is in the water wheel, it is going to make itself manifest in the light. I do not think it is very feasible to run the whole thing from the one machine, even though you had a separate circuit for the lights and a separate circuit for the power. As long as they are all driven from the one machine you are going to have the same result, because, if it is in the regulation of the engine, it is going to affect the lights. In Toronto, we are going to considerable expense in taking off all these heavy powers from our light circuit, and putting them on what we call a power circuit; at the same time we have been running on the three wire system for several years with a day load probably of about 1,500 or 1,600 amperes power load, yet it cannot be said to be extremely satisfactory. There are times when the light is unsteady because of the sudden increase and diminution of the loads, no matter how perfect the regulation is at the station and the engine running so that you could not see a variation in the speed with a tachometer. Yet we all know that by a sudden increase in the load there must be a variation in pressure; so, as far as I am concerned, I do not see that the thing is very feasible, no matter what the system is.

Mr. W. H. Browne: Mr. Milne has made a claim, I think, resulting from the fact that he has not had direct personal contact with the use of power on a multiphase current circuit with incandescent lights. He says, from his experience, that the change of loads of six, eight, ten or twelve h.p. make a blink in the light. I presume that many of you here have had theatre circuits on your incandescent lighting system; at least they have in

Toronto, anyway, where they may have four or five hundred lights in the border lights and the drop curtain lights turned on and off quickly. Four or five hundred lights represent a considerable percentage of the load on that particular circuit, and the cutting on and off of those lights affect all the other lights on the circuit. I presume that is your experience; it has been necessary in my experience in New York city to make a theatre circuit and have nothing else on, so that the lights for the theatres would be only affecting one another. You have precisely the same conditions in a motor power load, but you certainly can regulate for it; if your direct current machine does not regulate for it, your multiphase machine has its own regulation. We are turning on and off 40 and 50 incandescent h.p. without affecting our incandescent lighting at all, because by regulation of the machine the variation in the line is controlled. Get enough copper in your line and you can cut on and off 40 or 50 h.p., whether it be motor power or incandescent, and the other people will not know anything about it. The experience I had in theatre circuits taught me that lesson—it is easy to take care of it, and your motor load is no different from your incandescent lighting load. We had so many theatres in New York city that it paid us to make a theatre circuit. In Montreal we have five theatres, and each one of these is on a separate circuit.

Mr. J. J. Wright: It appears not to be so much a question of regulation of the machinery itself. I have not the slightest doubt that a good generator could be got that would regulate within a very small percentage, but the difficulty appears to arise from the drop of potential or loss of pressure locally.

Mr. F. C. Armstrong: In considering this matter in connection with the heading of Mr. Kammerer's paper, there is another point of view that has not been touched upon, and which seems to me is really more material to the smaller central stations who are not at present operating a day load, and the slight difficulties in the operation, and that is the commercial side of it. The main difficulty experienced, I think, in working up a power business in connection with the smaller stations is the difficulty of the high price of motors, under present circumstances at any rate. There is no doubt that the alternating motor in the smaller sizes which would be used up to 20 h.p., with the cost of transformers added, is two, three or four times the cost of direct current motors which can be put in, and which do the work; and I think that difficulty has been found to be a very considerable one. There are in Ontario at present 15 or 20 plants using either two phase, monocyclic or three phase apparatus. In connection with these I can only call to mind at the present moment four or five motors which are in actual operation; some of these plants have been running for a year and a half and two years. One I have in mind has been running just about two years, and there has been only one motor in operation since the start. If the price of motors had been brought down to about what you can buy a direct current motor at, the people would not long buy the direct current motor at the price it is. You can get around that by adding to your investment the capitalization necessary to supply the motors, but I think, considering everything, that is very doubtful commercial policy. In connection with the operating side of the matter, there are one or two points that I would like to touch upon. The difficulty which Mr. Browne spoke of in connection with his theatre circuits, realized from a change in load, would, I think, be experienced even more severely by smaller stations, because I agree with Messrs. Milne and Murphy that the difficulty is mainly a difficulty in the prime mover, especially in the operation of small units. It would seem to me, taking the average small plant, that the stopping or starting of a 10 or 15 h.p. motor would have a considerable effect on a 75 or 100 h.p. engine, and therefore a disastrous effect on the regulation of the lighting. There is another point, and that is, the difference between a direct current and alternating motor, due to the fact that with the alternating motor we have to contend with the idle or wattless currents. I am not

aware of any alternating system in which that difficulty is entirely removed.

Mr. F. Pepler: Would those difficulties be applicable to running an electric railway during the day?

Mr. F. C. Armstrong: In connection with lighting? Mr. Pepler: Yes.

Mr. Armstrong: They certainly would be. We have had some experience in connection with a certain plant in the matter of operating a day lighting circuit and a railway in connection with one another, and we find that while we can maintain a day circuit, it is practically impossible to do so from the same engine, although the engine is of the heavier size, about 200 h. p., from which we are running the lighting machinery. We have tried both.

Mr. W. H. Browne: Mr. Armstrong has responded to Mr. Pepler about the railroad, and it refreshes my remembrance about a statement he made in the course of his remarks that the difficulty appears to be in the prime mover, by which I infer that the prime mover is insufficient for its work, because if you have a prime mover on which you have a unit of so large a ratio, so large a percentage that the going on and off will affect your prime mover, be it a boiler or water wheel, evidently you have not got your conditions apportioned rightly. Mr. Pepler's question, as I understand it, was, what do you do with a railroad business? As a matter of fact I think we all know that the prime movers—boilers, engines and generators—are adapted for railway service so that the whole load may go off and yet its regulation is effected perfectly, the engine is governed and the dynamo is running at its normal speed. It seems to me it is entirely the question of the adaptation of units to the work they have to do. When we talk about theatre circuits being too large, it is meant that they are the largest proportion of the circuit or dynamo to which they are attached. In regard to small stations, the great difficulty I find with them is that the prime mover—the wheel, the boiler, the engine—is not large enough for the work they have to do. They have added on and added on, and put on more lights, and the consequence is they have got too much business for that particular machine, and if they put on a motor or lighting service which will come on and come off, they have more than they can take care of. They have not regulated their machines the same as they do the railway generator. Mr. Armstrong will tell you that he would furnish a generator for railroad purposes that would take the load, no matter what it was, and regulate it. The other matter is simply a question of adaptation, in getting your unit the right size.

Mr. Armstrong: To my mind Mr. Browne has brought out the difficulty even more clearly. It is perfectly correct that for the conditions of railway service we can offer generators which will give a regulation adapted to that service, and also that under that condition of operation the variation of a steam engine, even with such violent fluctuations of load as having the whole load thrown off instantaneously, will not affect the service. There is this difference in a railway service, that it has a variation of 10, 15 and 20 per cent. or more in line potential, and the voltage of a railway circuit will run from 550 to 500 volts, and the line voltage will vary even more. But Mr. Browne will admit it is quite out of the question to have any such variation in a lighting circuit, and that was the point I was endeavoring to bring out in my reply to Mr. Pepler's question. The variation in the prime mover, which is due to the change of speed primarily, I presume, is too great to keep the dynamo potential steady enough to permit of a satisfactory lighting service. Coming to the other side of Mr. Browne's remarks, while there is no doubt weight in what he says, that the cause of this difficulty which will be found in the operation of small plants by the putting on or off of a motor is due to the disproportion between the size, say of a 20 or 30 h. p. motor and a 75 or 100 h. p. generator, still I do not think he would propose as a remedy you should all put in 300 or 400 h. p. I think really that brings us back to the point brought out by Mr. Wright's bottle; it is quite possible to carry three or four or a dozen different

kinds of wine in a patent bottle, but it may not be the best to keep water.

Mr. Wickens: It seems to me that the mechanical engineer is the man who has got to get over the trouble after all. It has simmered itself down to this—it is actually the prime mover that is making the trouble. One of the difficulties is that we have got a good many points to reach in a convention of this kind. The kind of power that Mr. Wright and Mr. Browne have in view most of the time is not the kind of power that most of the other members are thinking about. You take a small plant, and when you come to make a load you are going to make some regulation with regard to the light. I do not think it makes much difference what system you use. Where the difficulty comes in the most is, for instance, take a small electric railroad where they are running two, three or four cars, and often times the load is all off on that kind of a plant. Now, if they were lighting a few lights here and there, there is no engine under the sun that would regulate close enough to make those lights serviceable at all; that is, if an engine is big enough to make sufficient power to pull four cars up a hill with a load, and loses all of that load excepting, perhaps, 50 amperes on a few lights, there is no engine built that will regulate that satisfactorily. No matter how well your engine regulates you cannot make your machine regulate the engine that is driving it. That is where the discussion has got to now. I think in my own experience, by putting in copper enough, and engine enough, and so forth, the matter can be brought down so that the regulation is very close. Take the stations in the smaller towns that have only a few lights in with their power loads, and those lights will be in cellars and places where it does not make much difference whether they are good or not, and if the lights did vary a little with a station of that kind, there would not be much fault found with it; but in the larger places, in Toronto and Hamilton for instance, where there are a great many lights used in stores and other places all day, that is the place where the main difficulty is. The difficulty is to get a light that is satisfactory if it is running in connection with a power service, and apparently we have got to regulate the engine better to get the light better.

Mr. J. J. Wright: I think the discussion has drifted off from its proper lines altogether. I consider that in a discussion of this kind the engine has got nothing to do with it. In speaking of this day load, and in putting in machines to do everything, whether that can be successfully done is the point; never mind the regulation of the engine.

Mr. B. F. Reesor: I see another trouble looming up. I cannot see why, in a large city like Toronto or Montreal, where the day loads of power and light would be pretty well mixed up, it would not pay them to put in a separate circuit. But what concerns me more, and also a good many others, principally in the smaller places, as a difficulty that would come in the way, is that the day load would be principally power; not very many places, probably very few in proportion, would be light; and in the outlying districts where the transforming units are small, what are you going to do with the drop? The transformers that are used in these smaller places have been in use a number of years, and they feel they cannot afford to throw these away and get nothing for them, and thus incur a great loss; whereas in a large place they can afford to do that. And, as I said, in the larger cities the proportion will be a little more equalized. In the smaller towns the lighting would be very limited, probably for the day only for butcher shops and places like that.

Mr. H. O. Fisk: In speaking of regulation, I would like to ask if any of the members have tried increasing the fly wheel capacity. In putting on a small extra load we found if there was a very heavy fly wheel it would carry that until the engine could recover. I was just wondering if anyone had any experience along that line.

Mr. J. A. Kammerer: Mr. Reesor in his remarks speaks of the transformer losses and their regulation. I distinctly mention in this paper that this is being brought about by the re-construction and re-arrangement

of the separate stations, and is the first essential step to the work. If you put transformers in that cost you money to keep alive at night, they certainly are not a good thing to have. That is why I favor reconstruction.

Mr. Farley: I am not very familiar with these questions, but I agree with the proposition that has been laid down here that there must be economy in generating electricity for all these services over the same lines and from the same dynamo. It would seem as if we had not yet arrived at that state where electricians all agree that it can be practically carried out, but for a small company such as I represent it is of very great importance. Where there are railway, power, arc and incandescent services it is like four stations, as it is now; and then there are the municipalities to deal with. There is the question of the increase of lines, which is an objection to municipalities, and which I understand would be done away with if all these could be done over the same lines without additional poles. In St. Thomas we have three or four miles of poles in some instances, and I am not able to gather whether this can be successfully worked out or not. But, as this is my first visit to the convention, I am very pleased with the intelligent discussion on these questions, and I believe that these Association meetings will result in a great deal of good, not so much to the larger cities as to the smaller places who have to struggle to live. I believe that as years roll by and these meetings continue to take place, and as the intelligence of electricians is brought into contact in this way, we will solve some of these questions that have been raised here to-day. I do not agree with the idea that the engine has not something to do with the question. I think it has a great deal to do with the question; and yet it does not settle the question that the dynamo, generator, lines and everything else have not to do with it. I shall be glad to attend the meeting next year and see if this question is solved. I must congratulate you, Mr. President, on your office. I am glad to find that you have been elected president of this Association. I hope that you will continue to be an officer of the Association.

Mr. F. C. Armstrong: Mr. Farley seems to have misunderstood the position which I took, as one of those who has not looked upon Mr. Kammerer's solution as the actual solution of the day-load problem. I think there is no person who will question the perfect feasibility and desirability of operating especially a small lighting station and supplying three or four kinds of service from one generator, one circuit, and one set of appliances all through. There are so many desirable things about such a circuit that it is not necessary to enlarge upon them at all. But the question simply resolves itself into one, that in commercial practice it is not found to be, so far as my experience goes, the easiest to work out under ordinary circumstances. As to the feasibility of doing it, any one of at least half a dozen manufacturers of electrical machinery have upon the market multiphase alternating machinery from which they can guarantee a perfectly satisfactory service for incandescent lighting, for supplying motor power and arc lighting.

Mr. J. J. Wright: I don't think anyone will dispute the desirability of this. I think I realize that almost as much or more than anybody here. If the whole of our output could be turned out from one plant it would make a difference in our income. I will give you one instance; it was caused by our trouble with the late fire. I actually had 2,000 h.p. of engines and 2,000 h.p. of dynamos all in position to operate, and I could not run even a measly dough mixer in one end of the city.

Mr. W. H. Browne: I have inflicted myself several times upon the members here, but I think I will offer one suggestion for consideration that may possibly help us out. In answer to the gentleman from St. Thomas, the cost of operating a central station probably rests entirely in the amount of money invested in the plant and the interest to be obtained for that investment as the first item; the next item would be the labor of having that plant in readiness to serve light or power; the third item of expense would be the actual coal, oil

and other material used in delivering light and power. We have two items all the time fixed—the interest upon the capital invested and the labor necessary to produce; so it may be ascertained by any one who has plant how much it will cost him to be ready to serve light or power. The additional cost that he will have will be the amount of coal, oil and waste that he will use up every hour that he is operating his station. When you come to put a day load on there, you do not increase the capital invested if you use the same boilers, the same engines, the same dynamos and the same wire. The capital invested remains the same. You do not increase your labor item, but you may increase your coal burning under your boiler to produce power. Therefore it is easily calculable what your day service is going to cost you and what you can get for it. And the benefit of that day service is that you reduce the proportion of your capital investment and your labor account pro rata through the hours of service that you get power for; that is why power service or day service will pay the station no matter how large or how small it is, because you are getting something in return for capital invested and for the labor that you necessarily employ.

The President: Mr. Browne, at what would you place the day load for 7,000 light capacity in a small town? How much would it be?

Mr. W. H. Browne: Of course, Mr. President, that will depend entirely upon the size of the units that you use.

The President: Take a place of about 10,000 inhabitants.

Mr. W. H. Browne: Taking old transformers and old methods it would mean a great deal, but taking it by what we do to-day—what we know we can do to-day—the transformer leakage for a 7,000 light plant should not be over 10 h.p., but with the old process it would be 150 h.p.

The President: If you have to run 30 or 40 h.p. for the sake of supplying 25 lights you would be very much out of pocket.

Mr. Browne: You should not cultivate the idea that you want to continue to operate a plant that is using up leakage load in that fashion; you cannot afford to do it. No matter how small or how large your plant is, you cannot afford to go on using transformers which are using up that amount of energy. It is being proved every day in small plants that they can afford to throw them all away and get transformers that anybody will make to-day for them. All of us will make them a good transformer that will reduce the leakage so that they can afford to run all day long.

Mr. W. Williams: There is one thing that Mr. Browne neglected to mention; he did not mention the cost of another engineer. You could not expect a night engineer to run all day.

Mr. Browne: I suppose Mr. Williams means that an engineer might cost him \$2 a day. I presume that the power that you would get would bring you in considerably more than \$2 a day. As I understand the day load, it is not your big power, it is not your railroad power, it is one h.p. here, two there and five somewhere else.

Mr. Farley: Supposing you had only that number, three or four?

Mr. Browne: You could not, perhaps, afford to do it. I have in my mind the case of a comparatively small town where they have a water wheel plant, and when I spoke to the manager of that plant originally about getting in power service, he said: "Well, I don't see any reason why I should; I would have to have another man on in the day time, and I don't believe I would get any, anyway." That was about two years ago. To-day that man has got in small powers, none of them larger than 10 h.p., and he is getting \$75 a horse power for it out of a water wheel plant. He can afford very easily to pay for his two dollars a day engineer.

Mr. J. J. Wright: I wonder if that is in Paradise. (Laughter). There is one phase of the subject that has been overlooked, and that is the overlapping of the

loads on railway and night work. It may be all right to get a number of motors, but in getting those motors and running them during the day for a certain amount of profit you may paralyze your means of overlapping; that may just knock out the whole of your calculations. You would then have to put in a reserve plant for your power instead of utilizing the same plant that has been put in.

Mr. B. F. Rescor : I would move a hearty vote of thanks to Mr. Kammerer for his able paper.

Mr. F. C. Armstrong : I would second that motion.

The President put the motion, which on a vote being taken was carried.

The President then tendered Mr. Kammerer the thanks of the Association for his valuable paper, which had evoked such an interesting and profitable discussion.

The President : Mr. Wilfred Phillips, who has been so extremely kind to us all, would like the members to go up at noon and take a look at his power house.

NEXT PLACE OF MEETING.

The President : The place at which the Association shall hold their convention in 1898 will now be taken up.

Mr. W. H. Browne : There is no place on the continent to-day, or rather there will not be next year, that will be so interesting from an electrical standpoint as the city of Montreal. There are being installed there two water power plants, that of the Lachine Hydraulic Company and the Chambly Manufacturing Company, and during next year both of these powers will be in active operation delivering current in the city of Montreal. They will both be characteristic in their own line—one will be characteristic for its vertical turbines and three-phase apparatus, made by the Canadian General Electric Company, and the other will be characteristic for its horizontal wheels operated under a high head and on the induction system of machinery; one will be operating at four or five thousand volts, the other at twelve thousand volts; and the power houses, dynamos and transmission lines will be all entirely new and characteristic. I certainly know of no place that can interest electric light people so much as the opportunity of seeing both of these in operation at the same time. From this standpoint and on behalf of the Royal Electric Company, I extend to the members a hearty invitation to come and see our power houses, and I am sure the Lachine and Chambly people will be very glad to have you all come and see theirs.

Mr. Thompson : Mr. Browne overlooked the mechanical engineer. He might have told you also, since he came from Montreal, that the street railway company are starting up a large 4,000 h.p. engine, and that will be in full blast next year. We have also several small stations such as we have been discussing, and there are two suburban railway stations, and I am sure that there is no place in Canada to-day where there is so much interesting information to be obtained, both mechanically and electrically, as there is in the city of Montreal. I have been down there over six years, and during the whole of that time between the universities, the small plants and the large plants, I have gathered up, I hope, a lot of very useful information. I am quite sure that if the gentlemen of this convention decide to come to Montreal, you will not only receive a lot of valuable information, but royal treatment.

Mr. Wickens : There is one thing in connection with going to Montreal : About ninety per cent. of our members live in Western Ontario, and while there is no question it would be very pleasant to go to Montreal, we will not get as large an attendance going that far east as we would if we held the convention in a more central place. People cannot spend the time; of course that is their loss. If we go to Montreal we are going to lose something. I feel satisfied we would not get as large an attendance there. We already know what kind of treatment they would give us; we have been there before. There is no place in the world where an association will be better treated than in Montreal, but I feel sure we would not get as large an attendance by going so far east as if we held the Association meeting in some of the more central places up through Ontario. We

have only nine or ten members outside of Ontario altogether; Montreal and Ottawa have a few, but the great bulk are in Ontario.

Mr. J. J. Wright : The best reply to that is the number of members we had at the Montreal convention. I think it was one of the largest conventions we have ever had, and I think some reduction could be got on the railway.

Mr. J. A. Kammerer : Getting on, say, at 2 o'clock you are in Montreal the next evening at six. The fare down by boat and back by rail is only \$12, including berth, and meals going down.

Mr. F. C. Armstrong : The selection of the place of meeting is particularly a matter which affects the central stations, and one which I feel some hesitancy in saying anything about. We people who are connected with companies do not pay our own expenses, and it does not make much difference to us where the meeting is. It seems to me that while Mr. Wright is correct in pointing out the large attendance at Montreal, this year's attendance is somewhat different in character from any former meeting of the Association, and in view of the important work that has been undertaken it is desirable to continue this attendance. I refer to the central station men, and I think the next place of meeting should be one which would best meet their convenience. From Mr. Wicken's remarks it seems open to doubt as to whether it is advisable to go away as far as Montreal; it would involve really a considerable expenditure for our members that care to go and especially those who take their wives with them, and it might tend to materially reduce the size of the attendance of central station men.

Mr. W. H. Browne : Perhaps the reason you have so many members in the west is because you have not cultivated the stations in the east; perhaps if you had your next place of meeting at Montreal you might add to your membership considerably by central station men from the eastern end of Canada. I suggest Montreal because I believe that it is the only place where really valuable instruction in what is going to be the future of this electric lighting business can be obtained. It had not occurred to me that it was a question of time; it had not occurred to me it was a question of distance or expense. And the gentleman who has just made a suggestion, I am thankful to him for it, because he said, you have not got very many eastern people here. Probably they found it too expensive to come west, therefore that might be a way of getting those interested in your Association.

Mr. Wickens : That is the way matters lie; we feel that the eastern men will not come up to see us; we hardly ever get any members from the east. The western man puts up his money and goes down east and sees what is to be seen there, and the eastern man stays there; he never comes up to see us.

Mr. John Murphy : The prevailing impression in eastern Ontario is that the Canadian Electrical Association is becoming an Ontario Electrical Association, particularly a western association. If the meeting were held in Montreal it would knock out that idea altogether, and undoubtedly bring in a great many people from the east.

The President : We held a meeting at Montreal, and we found there were not a great many Montreal people followed us up here.

Mr. J. Farley : We must not overlook the fact that we would not learn a great deal if we went to Montreal and saw all those immense power houses such as we saw last night at Buffalo; they are very often like the falls, magnificent to look upon, but for practical information perhaps you would find it more profitable to come to St. Thomas, Lindsay, or some such place. There is no place in the country that we are all more interested in than the great metropolis of Montreal. We all desire to go there, perhaps, more or less; we can go there during a later part of the season; there will be a lot of excursions, but if we want to get the practical side of this question, while we want to give it a national or Canadian character, any of the smaller places might be better than a large place, and it might

induce more to go. I had Montreal in my mind until I began to think the matter over, and I believe Ottawa would be a better place for the practical working of electricity than Montreal.

Mr. W. Thompson: I might point out the fact that four years ago when you held your convention in Montreal, there was practically then only one company in operation, that was the Royal Electric Company. During the past four years there have been wonderful changes taking place. The Royal Company has reconstructed its station. I have had the pleasure of going through part of that station, and it is really worth seeing. Then they are at the present time constructing the Lachine Rapid Hydraulic works; there are two new suburban stations both re-constructed since that time; outside of that there are quite a lot of small plants throughout the city and suburbs. I venture to say there is not one-fiftieth portion of the actual operating engineers outside of station managers of the city of Montreal that are members of the Association. Why, I myself was not a member of the Association; I don't know that I am yet, I just handed my application in today.

Mr. Mortimer: Yes, you are.

Mr. Thompson: If I had known five years ago that these conventions were as interesting and as valuable as they are, I would have been a member long ago. The question of expense certainly is a serious one. I have had to bear my own expenses coming here, and I consider I have got two dollars for every one I have invested, and up to the present moment I have only been here since seven o'clock last night. We want amongst our engineers intelligence, and no single man in this country has got a claim on all the intelligence that is going. It is only by an interchange of ideas and an examination of the practical work that we are to get it. I do not want to urge upon the members to go to Montreal personally, because I would rather come to Ontario, for then I get a holiday, but I really think for the benefit of the Association, and knowing as I do the practical experience you can gain, I cannot impress upon the members of this Association too strongly that they should come and see for themselves.

Mr. J. Milne: I think the best thing we can do is to decide on Montreal. I would make a motion to that effect.

Mr. J. Murphy: I have much pleasure in seconding Mr. Milne's motion.

Mr. Pepler: May I be allowed to put in a good word for the town of Barrie. With reference to the city of Montreal, I quite agree with what has been said. But if it is the feeling of the meeting to have the next meeting at some central point in Ontario, I do not think, excepting Toronto, a more central place can be found than the town of Barrie. So far as beauty of scenery and a social time is concerned, I do not think it could be beaten. We have a lovely bay there, on which there are boats running out into the larger lake. The manager of our company owns one of the boats, which I am sure he would be pleased to place at the disposal of the Association, on which the members could go to many points of interest, including Orillia and other places around the lake. Although we would not have anything electrically to offer like Montreal, yet for practical convenience and for a pretty spot and a happy time I do not think you could find a better spot than the town of Barrie.

Mr. S. Noxon: The matter of location for the next place of meeting should not go by default in this way. I make no particular claim, but while I was sitting here it struck me what was the matter with the town of Peterborough for the next annual meeting. Representatives from that city, for some reason, are exceedingly modest in not putting forth the claims of Peterborough. Although I am not opposed to Montreal, at the same time it is my impression that by meeting farther west we would get a far larger representation of those who take an active interest in central station business, that is, the central station managers; yet, at the same time, I would have no objection, providing I feel the same interest in the Association next year that I do now, in going to Montreal, for I think I would be amply repaid. It might also be said that we are all familiar with the generation of elec-

tricity in English, and we might go down there and see others do it in French.

Mr. Armstrong: Mr. Noxon has expressed his surprise at the modesty of the people who are connected with Peterborough. As far as Peterborough is concerned, it is a small place, and we have the modesty to believe that most of the electrical interest there would be connected with our own manufactory, and it would look too much like self-interest to urge going to Peterborough. A meeting at Montreal will give the members an opportunity of gaining a great deal of information as to construction, and of seeing a great deal of up-to-date apparatus and methods.

Mr. H. O. Fisk: We have built a new station in Peterborough, and at the present time we have not anything we would care for the Association to see. In another year we may be in a better position. It is a nice point for pleasure, but I take it we should not consider pleasure the first thing. I would be in favor of going to Montreal, because I believe there is so much there for small people like myself to learn. I consider it is like buying a book; if you only get one point out of it that is of value you have not lost anything, and perhaps you have gained a good deal. That is one reason I would be inclined to very strongly favor Montreal.

Mr. W. Williams: What is the matter with Sarnia, and there is London and Guelph?

The President: It has been moved by Mr. Milne, seconded by Mr. Murphy, that the next meeting of this Association be held in Montreal. Carried.

The President then called upon Mr. William Thompson, of Montreal, to read his paper entitled "Determination of the Heating Power and Steam Producing Value of Coals from a Preliminary Examination." (See page 119.)

Mr. Thompson: Probably, Mr. President, with your permission and the permission of the members, it may be desirable, before there is any discussion, for me to make a brief synopsis of the object in writing this paper. I know that it is a somewhat difficult question to tackle, but I think that those of you who have followed up steam engineering as closely as I know members of this Association have, will agree with me that our present methods of determining the efficiency of our boilers and our furnaces is somewhat crude. Now, let us look at it in this way: Supposing we are able to determine (which we are quite able to do with very little practice) the exact heat producing value of the coal which we are using. We will carry that over, speaking commercially, to the debit side. We want to be in a position to trace that heat. We, as engineers, get the quantity of water that we have evaporated and made into steam, and we call that efficiency, but it does not give us the information that we actually require. We want to know, if there is a loss, where that loss occurs. Let us trace it out in this way: We start by knowing the maximum quantity of heat that the coal will give; we then collect a sample of our fuel gases and ascertain the composition of them, and from that composition we are enabled to know the exact quantity of air that has been admitted to the furnaces. We are then enabled to determine the exact quantity of carbonic oxide that has been formed during combustion, and if we take and examine our ash and still continue our analysis we are enabled to determine the exact quantity of combustible matter that still remains in the ash, because none of our furnace or grate bars are perfect enough to give nothing but pure ash. We have first the composition of the gases, we have then the quantity of air admitted, we have the heat lost through the formation of carbonic oxide, or heat lost through imperfect combustion. We have measured our water or weighed it, or ascertained the exact quantity of water fed to the boiler; we have determined the moisture in our steam. We know exactly, then, what amount of heat has passed into that water or what amount of that heat has been efficient, and we can take it as being fairly reasonable that the balance of the heat, if any remains, has been lost by radiation. There we have a complete chain of events, a complete trace of the whole of our process from beginning to end, and we know just exactly where a loss exists. This may pos-

sibly give the gentlemen present a clue towards discussion, and I shall be very glad to hear from the engineers or any one interested who wishes information.

Mr. J. Milne : The determination of the heat value in coal is generally done by three methods, first, chemical analysis ; second, by combustion in a coal calorimeter ; and third, by actual burning under the boiler. There is some doubt as to the correctness of chemical analysis. The coal calorimeter is certainly, I think, the most correct method of arriving at it, but if the two experiments are properly conducted—the chemical analysis and the combustion in the coal calorimeter—the results do not vary very much ; but at the same time, when you test a sample of coal, or take a variety of samples from the coal pile and mix them all up and burn them in the coal calorimeter, that does not say the coal heat we are going to get for that day is of the same quality, because you all know, although you are getting coal from the same mine, that you will get good and bad cars of coal. I do not see, even if we determine the exact value of the heating properties of that sample or set of samples, that it is going to be of very much value to us. The thing is this : We can roughly approximate the heating value of coal, and I don't think that we can be very far out if we assume that as being very nearly correct, without going into any analysis or calorimetric tests. There is an instrument probably my friend Mr. Thompson is acquainted with it ; it is invented by a Mr. Thompson and is used by the North British and some of the leading lines in the Old Country—which I think it might be advisable to describe. It gives you the heating value of coal at once, almost without any calculation. You take a gramme or two grammes of coal ; after you have powdered it up, put it in a vessel and put in a certain amount of oxygen, you immerse this little combustion chamber in 966 grammes of water, or double that quantity if you are using two grammes of coal, and if that amount of water is raised one degree Fahrenheit, then that would indicate that we have one pound of water evaporated or boiled off into steam for the raising of the water 1° Fah. If you raise that 10 degrees, it is equivalent to 10 lbs. of water boiled off. If you want to find the thermal value of the coal you are testing you would simply take your 1,934 grammes—that is the amount of water—multiply that by the rise in temperature, and divide by the number of grammes of coal you are burning ; that would give you the exact heat value in the coal. I think that is the simplest method we have got, and it is just as accurate and near enough for all practical purposes, and from that you can easily determine roughly what the efficiency of your boiler would be.

Mr. Thompson : The use of the calorimeter is not such a simple matter as it appears. I am very well acquainted with this instrument in question, and I consider the information you get from it is entirely astray. We want to get the exact amount of heat, and you must understand we are dealing with a very small quantity of fuel. A certain quantity of that heat only is given to the water ; the metal itself absorbs a certain quantity of heat, and there is a certain quantity, no matter how carefully you conduct your examination, lost by radiation. The calorimeter constructed on the principles which are mentioned does not give the exact power of heat in coals, and it takes a very delicate manipulation to first ascertain the amount of heat that is passed into the water and the amount required to raise that metal receiver up to a certain temperature, and then the amount of heat that is passed off by radiation. Moreover, to the engineer this is not the information that he really requires, because there may be a great difference between the actual heating power of a coal and the industrial heating power of a coal. While we can test the industrial heat value of a fuel very nicely when we know exactly the condition under which that coal is being consumed, you cannot do that under a boiler, because the conditions exist and you know nothing about them ; you have simply to guess at them. Therefore, if we want to know more about the actual heat value of coal, we want, as engineers, before we can trace discrepancies in our plant, to be able to get at

the steam producing value, which varies according to the composition of the fuel, as I have said.

Mr. J. Milne : I am still of the opinion that the coal we buy must be judged by its heating qualities ; there is no doubt about that. If we buy one lot of coal at \$5 per ton, and get 14,000 thermal units per ton out of it, and for another lot pay \$2.50 a ton, and only get the half of that heat out of it, it is just as cheap to buy the dear coal as the cheap. What we want to arrive at as engineers is a simple method of determining the amount of heat, and the simpler the method is the more accurate will be the results. It cannot be gainsaid that that instrument by Lewis Thompson is perhaps used by the largest concerns in the world for determining the heat value of coal ; in fact, it is called for in the specification that the coal must be tested by it, so that there must be some good point about the instrument.

Mr. Thompson : I did not mean to say that the instrument was useless, but with the average information engineers have they are not enabled to use a calorimeter. Take our large Montreal plants as an example. I heard it said that during last year the Royal Electric Company saved some 6,000 tons of coal, and the Street Railway Company saved a large amount. Now, wouldn't it pay large concerns like those, where they are turning over thousands of dollars' worth of coal every year, to give their engineer the apparatus whereby he could intelligently determine the value of the fuel, and also determine how to use that fuel? The use of a calorimeter is a delicate operation, and is liable, even with the Thompson calorimeter, to give a great deal of error. The making of a proximate analysis of fuel fortunately is a very small matter. My method has always been this: I take a large quantity of coal and grind it up, and so intermix it that I get as nearly an average sample as possible ; then I go to the other side of the pile and make from 15 to 25 analyses and get as nearly as possible a fair average analysis of the coal in question, and it is surprising how these analyses will vary. No intelligent engineer would go and take the best coal he could see. If he did it would not be fair to himself or his employer ; he would make an effort to get as nearly as possible an actual sample, then the making, as I said before, of the proximate analysis becomes an easy matter. In cities where they can get almost anything they want from the wholesale chemist at greatly reduced rates the cost of an apparatus of this kind for the engineer soon becomes very little. They are more liable to get correct results from a chemical analysis than the average engineer is from the use of a Thompson calorimeter.

Mr. Wickens : When you are going into calorific tests it requires considerable ability and some apparatus. That is all right for a large plant. The larger plants, where they are turning over a good many thousand dollars' worth of coal in a year, can afford to pay for them, or they can send a sample of their coal to the neighboring college. To the ordinary engineer who is not an expert it takes a long while and a great deal of study to become expert, and you cannot run through the tests Mr. Milne or Mr. Thompson speaks of without being considerable of an expert—not only an expert in manipulating and understanding considerable about gases, etc., but you must be something of an expert at figures. Outside of a few corporations this thing is not of very much use to the ordinary engineer. While there is no doubt that the paper in its points is exceptionally well taken, it is not a thing that can be reached by a great many people. A firm that is burning two or three thousand dollars' worth of coal a year scarcely pays enough money to employ an engineer that has got that much ability ; they get better situations. The question in his case is, what are you going to do about combustion? He will go at it in a kind of thumb-handed way ; he weighs both water and coal, and eventually tells you he is getting so much evaporation for so many pounds of coal. He may not be exactly right, but I think he is very often as near right as the one who is going to figure up a small gramme of coal that represents some thousands of tons and tells us it is so and so. I think the man who goes at it on the other plan will be reason-

ably near; he will not be near enough to say it is absolutely dead right. I do not think there is an expert in one of our colleges that will tell us that he is absolutely correct; when he goes right down to the bottom of it he finds he has got to allow heat for this and that, and it is partly guess work. I feel that in that particular line, for weighing coal and water and taking the temperature of your slack gases, the whole thing can be done with a pair of scales, a thermometer, a little brains and carefulness, without very much elaboration. After burning a ton of coal you can tell whether a car-load, ten car-loads or a vessel load is going to be worth what is paid for it. I think for the ordinary engineer we have not the class of men that can reach to the height of knowledge that Mr. Thompson and Mr. Milne have attained to. I have found, from travelling around among the engineers throughout the country, that it takes a considerable amount of hard study to attain that particular knowledge, and we have not the means among our ordinary engineers for carrying out such an elaborate scheme. For the purpose of the ordinary engineer, or the engineer running a small plant, his own test is just as satisfactory to his employer as one that will be more elaborate.

Mr. J. J. Wright: It is nice to be able to determine the exact value of a sample of coal, but before that can be of value to the large coal user it will be necessary for Mr. Thompson or some other gentleman to concoct a scheme to compel the mining companies to send in the same kind of coal that we get in the sample. I have great pleasure in proposing a vote of thanks to Mr. Thompson.

Mr. Milne: The sample is really taken from the coal pile, and we have got the stuff there.

Mr. Wickens: I have much pleasure in seconding the vote of thanks to Mr. Thompson.

The President put the motion, which was carried unanimously. The convention then adjourned, to meet at 2 p.m.

During the noon recess a visit of inspection was made to the well equipped and arranged water power station of the Niagara Falls Park and River Railway above the cataract.

ELECTION OF OFFICERS.

The President called the convention to order at 2 o'clock, and stated that the first thing on the programme for the afternoon was the election of officers, and that nominations for President were in order.

Mr. B. F. Reesor: I would move that Mr. John Yule, our presiding President, be re-elected for the year 1897-98.

Mr. Dunstan: I have pleasure in seconding that motion. In view of the work that is before the Association during the year, I think it is very desirable that the affairs of the Association should be conducted by the same person who has inaugurated the work now in hand.

Mr. John Yule was declared elected President for 1897-98 by acclamation.

Mr. John Yule: I certainly am very much obliged to you for your confidence. I would rather retire and allow some other person to take the office, and I would give them all the assistance I could. I do not believe in one man holding the office for more than one year. There are a number of gentlemen here who ought to be ambitious enough to occupy the position, and who are more able to occupy it than I am. However, since it seems to be the wish of the entire Association, I accept the position and will do the best I can. I must return my thanks to the gentlemen who have attended here. The surroundings, of course, have had something to do with it, but since we have got you here we are able to show you what a benefit it is to attend these meetings, and when you go home and meet your neighbors and friends I hope you will induce them to come along with you to the next convention at Montreal. I might also say that we are very much indebted to the gentlemen who have stood by the Association during all these years. It was a struggle to get it along for a time, and now when it is getting on a sure foundation I think we are especially indebted to you; I do not mean myself, I mean the others who have staved with the Association. There is now a bright prospect of usefulness before the Association, and I would again ask the gentlemen who have come here and have seen the benefits and privileges of being a member to induce their friends and point out to them the advantages to be derived from this organization. I am now open for nominations for the office of First Vice-President.

Mr. A. B. Smith: I would propose the name of Mr. L. B. McFarlane.

Mr. J. Carroll: When leaving Montreal I was authorized by Mr. McFarlane to state that he would not allow his name to go before the Association as being eligible for election, and furthermore, if elected, he would not serve.

Mr. J. Yule: Perhaps Mr. McFarlane wasn't aware that the convention was going to Montreal next year.

Mr. J. Carroll: He told me positively not to allow his name to go before the convention. He stated that he had also communicated with Mr. Dunstan, and that he absolutely refused to serve, and if elected he would withdraw.

Mr. Dunstan: Mr. McFarlane has his hands very full of business at the present time. Personally, I would like very much to see him, and I am sure the whole Association would like to see him elected First Vice-President. The work of that position is not so great; it is not like the work which falls upon the president, and as the Association meets next year in Montreal it seems to me that we might elect him, and if he finds it is utterly impossible to accept the position (it would only be from pressure of work, not from any lack of interest in the Association—he would like that clearly understood), someone could then be elected to take the office. We could wire him and find out if he would accept the position.

Mr. Carroll: I think, judging from his remarks when I left Montreal, it would be a very great mistake to elect him. He

cannot attend the meetings, and feels he should retire. I would propose the name of Mr. C. B. Hunt for the office of First Vice-President.

Mr. J. Farley: Although I think we should endeavor to have one of our vice-presidents in Montreal, if possible, for the present year, I have much pleasure in seconding Mr. Carroll's nomination of Mr. C. B. Hunt.

There being no other nominations for the office of First Vice-President, Mr. C. B. Hunt, of London, was declared elected to the office.

Mr. C. B. Hunt: I am very much obliged to you for this token of your confidence, and I hope it will not be misplaced; with our President, I think we will get along very well.

Mr. F. C. Armstrong: I would move that Mr. J. A. Kammerer be Second Vice-president.

Mr. C. B. Hunt: I have pleasure in seconding the motion.

No other nominations for the office of Second Vice-President being received, Mr. J. A. Kammerer was declared elected to the office.

Mr. J. A. Kammerer: Thank you, gentlemen; I will try and assist our president to the best of my ability, and endeavor to make the convention a success.

Mr. C. B. Hunt: I would move that Mr. Mortimer be our Secretary-Treasurer.

There being no other nominations for the office of Secretary-Treasurer, Mr. C. H. Mortimer was declared elected to the office.

Mr. C. H. Mortimer: I have to thank you very kindly again, gentlemen, for the sixth or seventh time, for this expression of your appreciation.

The President: The next item on the programme is the election of five members of the existing Executive Committee to serve for another year. I will appoint Mr. E. E. Cary and Mr. W. Thompson as scrutineers.

Mr. A. B. Smith: While the vote is being taken I would like to move that the usual allowance be given to the secretary for the expenses of his office.

Mr. Dunstan: I second that.

The President: It has been moved by Mr. Smith, seconded by Mr. Dunstan, that the usual sum of \$75 be voted to Mr. C. H. Mortimer for his services during the past year. Carried.

After the ballots were counted the President said: I am sorry, for the sake of the time it takes up, to announce that the scrutineers have reported that there is a tie, and that we will have to have another ballot for one member in connection with the re-election of five members of the Executive. The four elected are: Messrs. J. J. Wright, F. C. Armstrong, John Carroll and A. B. Smith.

On a vote being again taken the President declared Mr. O. Higman, of Ottawa, elected as the fifth member.

The President: I am now open for nominations for the election of five new members to the Executive.

Mr. W. H. Browne: I understand there is a gentleman present who comes from a considerable distance and represents a territory which is comparatively new, and I would move in nomination Mr. F. A. Bowman, of New Glasgow.

Mr. A. B. Smith: I do not know of any man to whom we are more indebted for the arrangements of this convention than Mr. Wilfred Phillips, and I have pleasure in nominating him.

Mr. Wickens: I beg to nominate Mr. Thompson, of Montreal.

Mr. Thompson: I would rather Mr. Browne would take the nomination instead of me.

Mr. W. H. Browne: I believe that I can be of just as much service without going on the committee, and I would rather that you would diversify your committee a good deal more as to locality. Mr. Thompson, I think, would ably and properly represent Montreal. We who are in Montreal will take care of the Montreal interests without being on that committee.

Mr. F. C. Armstrong: I nominate Mr. Reesor, of Lindsay.

Mr. J. Carroll: I nominate Mr. Cary, of St. Catharines.

Mr. J. J. Wright: I nominate Mr. A. A. Dion, of Ottawa.

Mr. C. B. Hunt: I nominate Mr. Wickens, of Toronto.

Mr. W. H. Browne: I nominate Mr. James Milne, of Toronto.

Mr. J. J. Wright: I nominate Mr. Dunstan, of Toronto.

Mr. F. C. Armstrong: I nominate Mr. Williams, of Sarnia.

Mr. Dunstan: I nominate Mr. George Black, of Hamilton.

Mr. W. Thompson: I nominate Mr. Browne, of Montreal.

Mr. A. B. Smith: I nominate Mr. Bayliss, of Montreal.

The President: The following are the names of the gentlemen who have been nominated: Messrs. Bowman, Phillips, Thompson, Reesor, Cary, Bayliss, Dion, Wickens, Milne, Dunstan, Williams, Black, Browne. I would name Mr. H. O. Fisk and Mr. J. A. Kammerer as scrutineers to count the ballots.

On a vote having been taken the president declared Messrs. Bowman, Browne and Thompson elected, there being a tie for the fourth and fifth places between Messrs. Phillips, Reesor, Dion and Milne.

On a second vote being taken the president declared Messrs. Phillips and Dion elected.

The President then called upon Mr. F. C. Armstrong to read his paper entitled "Why Some Lighting Plants Do Not Pay." (See page 117.)

Mr. Armstrong: Before proceeding to read this paper I would like to explain that it is very incomplete. Unfortunately the preparation of it was deferred until too close to the time of commencing the convention. I did not realize the scope of the paper, which really covers the whole lighting industry and operations in detail and in every other way. The first part of it was prepared and sent to press before I found that difficulty to the full extent, and I could not re-cast it, so I had to cut it in two in the middle.

Mr. Armstrong then read his paper.

Mr. W. H. Browne: I think that a most enthusiastic vote of thanks is due Mr. Armstrong for this paper. It is very ably thought out, closely and well put together, and nearly every item is worthy of the highest commendation. I think, however, that for the purpose of raising the discussion I will take issue with him on the question of meter rates versus flat rates. As I take it from this paper, he believes that the method of selling current by flat rates for small plants is better than meter rates, and that for large plants meter rates are better. In my experience I really find no difference between small and large plants. I think the same principles govern them all, and the experience that I have found with flat rates is that your maximum output is taxed to its utmost with less result in the income than by the meter system; in other words, by the meter system you are able to get a larger or higher amount in revenue than you can by flat rates. There is no way that I know of to check the consumption of current by your customers on the flat rate system, and the result is that you tax your load capacity, for the income returned, far beyond what it should be. I would recommend every man to serve his customers entirely on the meter basis, and starting from that standpoint to make a bid for the increased use of current on our hours; in other words, to make the rate for the first hour of service—I use that word because that is pretty nearly the average use with regard to residential and small commercial current—make the rate for the first hour of service such a one as will make a return on the investment and cost, and make your second, third and fourth hours of service exceedingly cheap. You will find very soon that the people are going to find means for using your current for lighting and power, because the cost beyond the first hour is so small that they can afford it; they become educated, and the result will be that you will get, instead of an hour a day average, probably about three hours a day, in your lighting service.

The President: How do you arrive at it in making out your accounts?

Mr. Browne: The idea is this: your customer has a certain number of lamps on his premises; you of course know how much that is; your meter ratings every month will tell you the number of hours of consumption; that will tell you whether that man's consumption has been one hour per lamp per day or more. Divide the number of lamps into the number of hours and the number of days, and for the first hour of service charge him your price, and for all the hours beyond that, whatever they may be, a lower price.

Mr. John Farley: That is the same as the gas company; they charge a certain rate up to 5,000 and then reduce the rate for the next 5,000 and the next 5,000 again.

The President: Not exactly.

Mr. F. C. Armstrong: In connection with what Mr. Browne has said, the method he speaks of is, I believe, quite general in England; it is practically giving a discount, as I understand, to the consumer, which is proportionate to his use of the current during a certain period. It seems to meet the difficulty from one point of view to a considerable extent, but my idea in pointing this out and taking the position which I did was to get the views of the owners of the smaller stations present who have had actual experience. One difficulty I have found myself in operating the smaller classes of stations in towns of 5,000 or less, is the failure to get sufficient annual revenue at all, on any basis of rates, that will admit of the use of light on the lamp hour basis. I would like to ask some of the central station men what their experience is, both those who have gone on the contract basis with a sliding schedule of rates, and those who have used meters.

Mr. W. H. Browne: I thought some of the gentlemen here operating small stations would answer more readily. I happen to have in my experience two small stations in which the flat rate system was in operation; one of them was a 1,000 light plant; the other was a 3,000 light plant. I changed both of these on to the meter system. I did not change them to the system I have just been outlining—for I confess that is rather a new departure with me—but I did put them on the meter basis, and instead of having a 1,000 light plant I obtained over 4,000 lights, served from that same plant, and each individual customer paid a great deal less money, but I got a great deal more money out of my 1,000 light machine on the meter basis than I could on the flat rate basis. When I asked a man \$3.00 a lamp a year he objected, but he might pay \$1.50; and on the meter basis he could pay \$1.50, and somebody else would pay \$1.50, and so I got out of my 4,000 lights a larger amount of revenue than I did out of 1,000.

Mr. S. Noxon: I am glad to see Mr. Armstrong has cracked a nut and exposed the kernel to view on a question which is of great importance to small central station managers. I was anxious to learn from the discussion here the relative merits of the flat rate and meter systems of selling electricity from those who have had experience, for the reason that we are supplying electricity upon the flat rate basis, and although we have discussed and pondered over this matter to a considerable extent the objections which seemed to present themselves to us were of such an insurmountable nature that we could not see our way to changing our system. And in this I will have to differ from Mr. Browne in his experience. I think it is easier to get a customer to pay a uniform rate per month on a flat rate than it is to get him to pay a large rate per month during the heavy lighting season, and a much smaller rate during the summer months, for the reason that the customer's attention is attracted very much more forcibly by the maximum amount he pays. The minimum amount costs no figure with him; he does not realise that his average is a certain amount; perhaps he would if he figured it up, but the greatest trouble with most of our customers is that if you present a large bill to them they think it is outrageous. Now, I believe, so far as my experience is concerned, that you can do better upon a flat rate, and you can make your arrangements with your customers better

than you can with a meter system, for the reason that it is easier to make a yearly contract on a flat rate. On the meter system, on the other hand, your customer agrees to pay so much for whatever he uses; he naturally feels he should be in a position to either take your goods or leave them alone as it suits his fancy, and for that reason your revenue is much more stable under the flat rate than under the meter system. The only question which might arise is the gross revenue which you get. But as regards the feasibility and practicability of working the two systems in connection with a plant where you have keen competition from gas, I believe, and unless some argument is presented which will have greater force than those already presented, I still must be of opinion that in a small plant the flat rate system is better under all circumstances and conditions than a meter rate.

Mr. W. Thompson: I have the misfortune to be one of the small central station managers, and I have listened with a great deal of interest to what the gentlemen have said. I have at the present time both meter rates and flat rates, and I must say that the flat rates are an abomination to me; there are several reasons why. When we started in business we undertook to serve current by the flat rate, and in thinking it out it meant a great deal. The ordinary house, with us, gets about from 15 to 20 lights; and the houses being in a residential suburb are very much scattered. We had to provide alternating transformers and secondary mains. Where we put 20 lights in a house on the flat rate system we had to provide 20-light transformers and also a corresponding capacity on secondary mains. We very soon found that the capital outlay for putting in the extra transformers and secondary mains was going to swell up so much every year, and there was only one way to get over the difficulty, and that was to put in meters. We undertook to do that. The consequence is that on a 500-light machine I am able to put a thousand lights, and during four years I have never seen that machine loaded above 70 to 80 per cent. of its capacity. I venture to say, by cutting off the balance of my flat rate contracts and putting them all on the meter system, I could double that machine and still it would do its work. Not only that, but in one case I have two 50-light transformers working together and there are 200 lights working off that, and in the four years I have not even had the fuse broken. Supposing I had to provide current on the flat rate, with copper enough to carry over that amount of current, 200 amperes, and with transformer capacity enough, why, the capital outlay and the income from flat rates at 30 cents a month wouldn't pay the interest on the capital alone. Every amper that we deliver into the residences or into business houses we are entitled to be paid for, at a fair rate; consequently we are entitled to be paid on the meter basis. I think so, and I strongly adhere to the principle, and I think if this gentleman (Mr. Noxon) would try the meter basis he would very soon find out which brought in the most money.

Mr. Armstrong: I cannot agree with Mr. Thompson, in spite of his statement that it is his own experience, which is somewhat modified by the fact that he is close to Montreal, and therefore governed by city conditions which exist, as to the relative desirability of the two systems. Speaking of my own experience, I know that in a majority of cases they do find it better, as Mr. Noxon points out, to make a contract on a yearly basis than to deal with meter charges, which vary so widely. And, going back to the point which I outlined in my paper, that is, what your meter measures, I believe when Mr. Thompson states that you should have pay for everything which passes through your meter, that would be quite satisfactory if you could measure it. But the measuring of amperes hours does not really represent the value of what is going through your meter, and that is just for the reason I have given in my paper. If taken off at 6 p.m., at the time of the maximum load, every unit you are supplying must pay its full proportion of what is invested for plant capacity; if taken off at a later period of operation it is not necessary to charge it with that proportion at all, and therefore it does not cost as much, and should not be sold for as much; it is really a different kind of unit, looking at it from a commercial point of view.

Mr. Pepler: I think this question comes home in reference to a small plant. Referring to our experience, I may say we had a flat rate, and our great trouble was that with the load we had to carry we had no possible way of checking the consumption. At the same time, we realized that it was the most popular plan. There is no question, it is easier to deal with customers on the flat rate than on the meter plan. However, all things considered, we determined to adopt the meter system, and we are now on that system, but it is not altogether satisfactory, more particularly with regard to the question of popularity. When you are in the hands of a municipality you have got to consider that question. We are now considering this scheme (partly by way of meeting the demand there certainly is for a flat rate—people say they want to know what they are about; that is the position they take and partly by way of increasing the number of our small consumers): we are proposing to have a sort of combined plan; to confine the meter plan for large consumers and offer a flat rate to very small consumers, say, five or ten lights, at a certain fixed sum per year. We are also considering the advisability, in fact, we have concluded to do it, not exactly as Mr. Browne suggested, but to make a reduction to large consumers on the meter plan; a discount to consumers of \$75, and a still larger discount to consumers over \$100.

Mr. W. H. Browne: I think the difficulty of dealing with customers is very largely magnified. It has been my experience on the meter system to get into the business with a company that was serving entirely on the flat rate basis, and initiating the meter system. My clerks said to me, when the customers complained of the size of the bills, what are we going to do about it, Mr. Browne? I said we will adopt this uniform plan; in the first place, we will endeavor to get lumps that will consume a given

quantity of current that we can know are within a certain reasonable range. We will insist upon our station men operating the plant within a reasonable range of pressure, so that we will be able to know that a given number of lamp hours, when burning, should represent a given number of hours of registration; that will be our first work; and when we have done that we will say to our customers: If you find any fault with your bill consult your meter; read your meter; you can read it as well as you can read your clock. I adopted the uniform plan of making a test for a given number of hours with all the lamps burning, and reading and comparing the number of hours by the registration of the meter. That plan has always succeeded; the man never complained the second time; he was able to go and read his meter, and check it up every day. Not only that, but the managers of large places who are dependent upon their employees for the turning on and off of their light are able to use the meter as a means of checking their consumption by their employees. In one notable case that I had in my experience, the manager of a large institution had every meter tabulated and had printed forms showing the number of lights connected, and what they were, and the registration of them presented to him every morning, so that he was able to know exactly whether there was any use or abuse of the lighting. The great trouble we find in the business is that our commodity is too expensive. It is a luxury, and our efforts should be to offer it to the public so that they must buy it of necessity, not as a luxury. The flat rate system insists upon a high price as the first requisite, whether the man wants to use the light or not, and he objects. But if you say to a man, take this light and use it just as your needs and your pleasure dictate and pay for what you use, his individual bill is less than it would be by the flat rate; and it simply requires to make the man know that he has to pay for what he burns to get him to use it. You can get \$1.50 per lamp out of a man easier than you can get \$3. He is apt to look upon the meter system as he looks upon meters in connection with gas. But let us take the position and say: Gentlemen, we have a commodity to sell; we are honest about it, we want you to measure it and check it up and pay for what you use. Charging by the flat rate is not honest, it is not fair to the consumers or to the electric light man; it is not fair to the consumer in the summer time who does not need to burn it, and yet has to pay for it; it is not fair to the consumer in the winter time to pay \$10 when he has only used \$3 worth. We should cultivate an increased use, not by making a discount on it for the sake of the dollars in it, not because a man's bill is \$75 or \$100 a month; that is a matter of no consequence; the man that pays you \$75 may not be as good a customer as the man who pays you \$5. The man who uses your current up a great many hours of the day is the man you want to make the price for, so that he will be obliged in self-defence to buy it. I recommend to the consideration of all here the idea of getting the electric light down to a lower price. I believe that will be the way in which central stations will pay.

Mr. B. F. Reesor: I am thoroughly in sympathy with this idea of using meters; as fast as we can we are working into the meter system. Of course, you understand, you get all kinds of stories; there is a good deal of talk about the meters with a good many people; they think they would rather pay a flat rate because they say we want to know what we are paying for. The answer to that is, go to your grocer and ask him what you are paying for groceries per year; why, the man would laugh at him. In the flat rate system, as you all know, you have got to make a rate and allow for waste in stores, etc. In the business portion of the town where one man has a rate he pays a certain price and we have got to charge him more than we naturally would charge him because we expect him to waste his light. In letting his lights burn it is an advertisement as far as he is concerned. If he had to use coal oil or gas he would not use those lights after hours. When he has a flat rate he lets them go as long as they like. The next man to him has a meter in; he closes up his place of business and shuts off his light. If there is anything unusual going on and he wants to advertise his store front, he turns on his light and is willing to pay for it, as far as the meter rate is concerned. I quite agree with Mr. Browne that we should make our rates low; people will use more. Just before I left home I closed a contract with a large firm in this way: We put in a certain number of lights in his mill and charge him a minimum rate per year; he thinks he will run all night at times—24 hours a day. They start at six in the morning and run until six at night. Then in the fall of the year they have to light up when it gets dark after six, and then in the morning when they start up they have to light up, putting out the lights at daylight. If they run all night they will use a great deal more current, and the contract is that we charge him a minimum rate per year; if he does not use an ordinary amount of current he must pay so much; if he uses a certain quantity we give him a discount off. We give a discount, in any case, if the account is paid before the 10th of the month. If he uses a larger quantity he gets a larger discount, and we make the rate low. We do the same thing with other customers. Some of those who have mills talk the same way; they say we do not want to have a meter because we have no confidence in them; we do not think they will register right; we have had experience with gas meters and all that kind of thing and we want to know what it is going to cost. And I say, go to your grocer and buy your groceries that way.

Mr. F. A. Bowman: I have been using meters now for about five years; we have flat rates as well, but our object is, as fast as possible, to work our customers on to the meter rates. We take no customer using over four lights on anything but the meter system. My experience is that it reduces the consumption of light. You can over-wire very much more largely when you have a number of meters in than you can under any other conditions. When we

make flat rates we base them on what we consider would be a fair average consumption through the year; you cannot give more than a few different kinds of rates, and the result is a great many of the customers through carelessness consume a very much larger amount of light than your rate is figured on. I know you have to keep constant watch or else you will find them leaving the lights on; you will find a customer leaving his lights on every night and letting them run all night, and things like that. I know, of an instance, fortunately not my own, in which every store in the town is left on till the plant is turned off. My customers use me very much better than that, and as a rule they shut their lights off; still, you have got to watch them to a considerable extent. Take houses on meter rates and on flat rates, and I think you will find a very great deal of difference; you take an ordinary sized house, it has between 20 and 30 lights; if you put them in on the meter system there are about two, three or four lights in the house that practically make the meter bills for the month, say in the front hall, the sitting room, the kitchen and perhaps the dining room; the rest of the lights are used comparatively little and they cost the man practically nothing in the year. You give that customer a flat rate and go past that house on an evening and you will find three-fourths of the lights in that house turned on from dusk until bed-time. I think I saw it stated in an English paper that when lighting residences on the meter system you can depend on the consumption, that is to say, the number of kilowatts going out at any time, as being about 35 per cent. of what you are wired up to. When we give flat rates most of us figure on 16 c.p. lamps, whereas on the meter basis we can figure on 5 c.p. and 10 c.p. Although the lamps are not quite as efficient as the higher class of lamps, on the whole I think we will generally find it to our advantage to get meters introduced into the small plants as fast as possible. You know a great deal better what you are doing and you have the certainty that you are getting paid practically for all that goes out. I might say in this connection that I have rather a unique scheme; I have a small town where I am lighting the streets on the meter system; in other words, we put in an independent circuit, on a three-wire circuit, centered at the town hall, and they have a meter and switch of their own and simply turn the lights on and off whenever they like. We have no contract with them. As a result, I think they are satisfied. The arrangement has been running about a year and a half now, and they gave me an order to put in very considerable extensions to the system, so I think they are tolerably well satisfied.

Mr. H. O. Fisk: In regard to the flat rate system, we ran against a snag that I have not heard mentioned; we started with a contract for 16 c.p. lamps at a certain rate, then 10 c.p. at a certain rate, and we found after a while there were a great many 10 c.p. used. They said they were as good as 16 c.p. lamps. This thing went on in this way for a year or so, the load got tremendously heavy, and the income didn't come up, so we put an unknown man on the road to investigate. He went around and looked at all the lights and the result was that about ninety-eight per cent. of our 10 c.p. lamps were 16 c.p. The company then decided they would have no more flat rates for anything except 16 c.p. lamps; so they made a contract for 16 c.p. With reference to the meter rate, I might say we made a discount about a year ago of 33½ per cent. of what we were charging, for all bills paid before the 10th of the month. The result was that by the 10th, or at the latest the 11th of the month, all our bills with the exception of perhaps one would be paid in cash in the office, and that one you could look out for, because if he didn't wish to take advantage of the 33½ per cent. you could watch him. I might say also that in a year we almost doubled our number of units in that way, and we find that that load is the best paying load we have got. We get a larger return for the number of amperes put out than we do in any other way.

Mr. S. Noxon: I understood Mr. Browne to say that by using the meter he would make a reduction in price, and that his revenue came up even in spite of that on account of the extensive use of the light under the meter system. I would like to know how that operated. Of course there are two items in the calculation as between the flat rate and meter rate, and that is the relative price you get for either. It doesn't make any difference how "flat" your rate is providing you get money enough. It is all a matter of revenue for the service which you give. If you mean by a flat rate that you are going to get \$2 a lamp for every lamp installed, there is no doubt you would not get much of a revenue, but if you get \$4 you will have a pretty good revenue. If you are safe in having your installation from 25 to 40 per cent.—

Mr. Thompson: In residential work you might safely double the capacity.

Mr. Noxon: That is so much better for the argument of the flat rate. If you are safe in installing double the capacity of your dynamo, as Mr. Thompson said, on the meter basis, will it not apply to the flat rate?

A number of voices: No, No.

Mr. Noxon: If you are safe in installing double the capacity of your dynamo, then, of course, you can make your rate less to correspond with the cheap rate which you would have to give on the meter basis?

Voices: No, No.

Mr. Noxon: Why not? If you can depend upon their only using half of the output, it will amount to the same. If you can depend upon that, why can't you make your flat rate correspondingly less? Where are you in any worse position? Now, what I say about the flat rate is this, and as we have not discussed the price of the flat rate, my argument on the flat rate holds perfectly good until the price is established. After the price is established, then it is a question whether that price will pay or not. If you have a 1,000 light machine and you can install 2,000 lights and

can get \$2 on a flat rate for these, you get \$4,000. Can you get any more on your meter system?

Mr. Browne: Certainly you can, and the objection to your argument is this: You say, establish the question of a flat rate without regard to price, and you can double your installation. The lower you make your price —

Mr. Noxon: I said, when the price comes to be discussed it might change the conditions. What I say is this, that providing you can get a rate on the flat rate basis which would equal your income from your meters, then where are you at an advantage?

Mr. Browne: Leaving the question of the price out, the lower the price is on the flat rate basis the less chance there is of overwiring. The only way that you can secure the opportunity of overwiring would be to charge a high price on the flat rate. Mr. Bowman told us a little while ago that in England the experience is that on residential lighting 35 per cent. of the lamps installed is the maximum load. That is a high percentage. In my personal experience, I had a plant in which we had no residential lighting of any kind; it was entirely commercial business, hotels, saloons, theatres, stores and so on, and the maximum burning at mid-winter, in holiday times, did not exceed 60 per cent. of the lights wired on the meter. My experience in residential lighting is, although Mr. Bowman says it is 35 per cent. in England, that it does not equal 30 per cent; in other words, you will have 1000 lights wired up and 300 is the maximum burning. Therefore, you are able to serve all of your customers with your 300 light machine, and you are able to get your revenue from the full capacity of that machine. You have not got to put in a thousand light machine to serve a thousand customers. You are not going to get the revenue out of your machine on flat rates that you will on meter rates.

Mr. Noxon: This is a question in which I think not only myself, but a considerable number, are interested. What I wanted to satisfy by this discussion is this, that what Mr. Browne says is correct, that you are safe in wiring up three times the capacity of your machine. We have lately put in a thousand light capacity, and I want to know if it is the opinion of those who have had experience that we are safe in wiring up to the extent of 3,000 lights on this machine?

Mr. Browne: If you use the meter basis. If you have residential lighting and commercial lighting together you can easily wire 3,000 lights on a thousand light capacity.

Mr. Bowman: It looks to me as if somebody is investing a great deal of money in this thing that is not going to bring great returns. If your machine is employed only to that proportion of its capacity, I cannot see where the revenue comes in unless somebody is paying a great deal more for their light than they should be.

Mr. Browne: In answer to your enquiry as to how much you may wire: In the city of Montreal to-day we have wired up on our circuits 65,000 lights; we are serving those lights with five 300 kilowatt machines, that is 1,500 kilowatt capacity, and we always have one to spare.

Mr. Thompson: I think Mr. Noxon really misunderstood what I said. I meant to say that on the meter system I was quite safe, (and that has been pretty well borne out from facts, and I know from four years' actual observation and experience that I have proof of what I say) that I could safely, on the meter system, put on 2,000 lights on my machine. Now, supposing that I sold those 2,000 lights on the flat rate, and that all our customers were perfectly honest—unfortunately a lot of customers, when you put them on a flat rate, use 16 c.p. lamps instead of 10, and I have known them to use 32 c.p. instead of 16; I have known them to pay for 15 lights and install 25—you may take it for granted with the most honest of customers that at some time during the night you are going to have your full maximum of 2,000 lights on, consequently you must provide 2,000 light apparatus. What does that mean? It means that your 2,000 light apparatus is simply bringing in the income that you could bring in on a 500 or 1,000 light apparatus.

Mr. Armstrong: This discussion seems to have drawn out considerable discussion; those who are in favor of the meter system stick to the point that they are right, and the other gentlemen express themselves with equal confidence. It simply establishes the fact that it is all a matter of conditions. What I contend is, and the purpose of my paper was, that for small plants—I mean plants in towns of from one to three, four or five thousand people—the contract basis has proved itself in actual operation to be very satisfactory. I have in my mind the case of the town of Penetanguishene, where the plant installed was put in some four years ago; it was put in on the basis of the idea which Mr. Browne has just expressed, and which at that time was very clear in my own mind, that the way to make money out of the electric light business was to sell the light cheaply. In establishing the rates a good deal of care was taken to make the sliding scale equivalent to a meter basis. The result is that that has paid the stockholders very handsomely. The system has been extended as far as the size of the town will permit, and they have some 1,700 or 1,800 lights. A fact that has been established is, that on the basis of charging for lamp renewals you can very largely realize the conditions of the meter plan. With respect to overloading machines they have, up to the present, without any difficulty, been able to operate that number of lights from one 60 kilowatt alternator. I know also of an example in residential lighting where they have about 30 or 60 lights in, and on an average they do not use more than half a dozen or eight lights; there is no object in keeping their lights blazing all through the house. I could give instances of a large number of similar cases in towns of a similar size where by the flat rate system they have realized nearly the same conditions as under the meter system; where, so far as making money is concerned, the flat rate

approximates closely to what a meter rate would be. Then you have the expense of meters, which is quite a capital charge on the plant. Then, under the flat rate, you have the advantage of a clean cut business; you know what your revenue is going to be to a dollar, and the only increased cost which the contract basis may allow an opportunity for is the increase in fuel, and that is not, in a small plant, very large. I do not wish to be understood at all as saying that that applies in all cases. In all the larger plants and in some special cases with the smaller plants, a meter basis is not only desirable but necessary. But I am speaking generally for a certain class of small stations, some of which, I think, are represented here, and from the owners of which I would like to have heard an expression of opinion.

Mr. J. M. Brown: It seems to me this question is largely a matter of expediency with regard to small plants. I happen to run a small plant in Carleton Place. When we started out we had the idea of putting all the residences and as many of the stores as possible on the meter basis. They did not run very long until they began to kick and said their returns were too light. I came to the conclusion then, that in order to work up a business, it would be better for me to adopt a flat rate right through. We did so and gave a very reasonable rate, and we have, of course, installed more lamps, but I can clearly see that in the near future my plant will be loaded up and I will have to go back to the meter basis or else put in more apparatus. Now, there is another point: I think that for commercial business in a small town you have got to have a flat rate for the simple reason that a good many stores close, say, so many nights a week; and I even know of one town not very far from me where only last year they closed all their shops at six o'clock in order to cut off the electric light and heat. In that case they were running on the meter basis. If that town were on a flat rate they would have been getting an assured revenue from commercial lighting. I think for commercial lighting you should have an assured return to pay for the capital involved, to carry that amount of lighting. For residences I believe it should be run on the meter basis, and on the meter basis only, to be satisfactory to central station men. At the present time we are running them half on the meter and half on the flat rate, and I know for a fact that those who are on the flat rate are using three or four times the amount of light that the other people are, and I am getting very little more money from them. I can take residences that have 50 lamps on the meter system, and they are not using, on an average, through the heavy lighting part of the evening, more than 10 lamps. Other residences with a less number of lights in, on the flat rate, are using frequently 20 lamps right through the heavy lighting part of the evening. They do not always do so, but they frequently do. In any event they use nearly double the amount of lamps that residences do that are on the meter system, and I get very little more out of them. So that I believe the meter rate is the only practical way to get over the difficulty in connection with the residence portion. But, from our own standpoint, I prefer the flat rate for commercial lighting. You could not get hotels on the meter basis at all; they would not use the light no matter how low a rate you gave them, for the simple reason they claim they have no control over their light. We get the commercial rate from hotels, and although they use a considerable number of lamps all night, those lamps are on when the load is light and the power is not of so much consequence to us; it doesn't tax your capacity in any way, and you get a good revenue from them. If you put them on the meter system they would not stay with you at all, for they could not stand it.

Mr. Thompson: I beg to move a vote of thanks to Mr. Armstrong for his excellent paper that has brought out so much discussion. I am sure we have all appreciated it very much.

Mr. Noxon: I beg to second that.

The President: I have great pleasure in tendering to you, Mr. Armstrong, the vote of thanks from this meeting. We would ask those who prepare papers for the next convention to choose subjects that will evoke discussion and difference of opinion, and bring out what the experience of different members is in different localities.

The President: I will now call upon Mr. C. E. A. Carr, of London, to read his paper entitled "The Commercial Aspect of Electric Railways." (See page 122.)

Mr. Carr: Mr. President, gentlemen and members of the Association: The subject of my paper as announced on the printed sheets is rather misleading, as the paper was written before I had the subject sent to me, therefore it appears on the paper "Electric Railways, and How to Make Them a Commercial Success." I do not know that the paper will have as much interest to most of you as the paper read by Mr. Armstrong, because not many of you, I understand, are very closely connected or associated with electric railways.

Mr. F. C. Armstrong moved, seconded by Mr. W. H. Browne, that a vote of thanks be tendered to Mr. Carr for his valuable paper.

Mr. Browne: Mr. Carr, from a railway standpoint, has amplified what I think is a necessity with all businesses, namely, good employees and loyal employees, who make themselves interested. This is necessary to the success of electric lighting, railroading or any other business.

The President at this point called upon Mr. W. A. Johnson, of Toronto, to read his paper on "Accumulators—Their Application to Central Station Lighting and Power." (See page 125.)

Mr. C. B. Hunt: I have very great pleasure in moving a hearty vote of thanks to Mr. Johnson for his valuable paper.

Mr. J. Farley: I have much pleasure in seconding the motion. While all the papers have been, to my mind, exceedingly interesting, there is none probably that has a more practical bearing on the future than the one just read.

Mr. W. H. Browne: Before passing the resolution, I notice that the question of the cost of installation was referred to, but nothing said, I believe, as to the cost of operation or maintenance account. Could you add anything on that line, Mr. Johnson?

Mr. Johnson: I refer to the question of maintenance very briefly here. I simply stated that it had not been found to be excessive. So far, for about three years on the North American continent, during which time the modern type of battery has been in use, the cost of maintenance has been found in central stations to give good evidence that repairs will not exceed from three to five per cent. of the cost. The manufacturers give a perpetual guarantee that the cost will not exceed 10 per cent. in any case. It has been found in all the more recent stations installed that the companies purchasing have availed themselves of the privilege of doing their own repairs, and if there is any difference between that and 10 per cent. they save it. But there is a definite guarantee of 10 per cent. given in all cases where they expect the plant will receive reasonable usage. I have no further figures than these. I may say, however, that in several plants in Canada these figures have been found to hold good.

Mr. Browne: The object of my inquiry was, I had understood that manufacturers of storage batteries were willing to guarantee that the maintenance or repair cost was considerably lower than 10 per cent.; in fact, I have heard them declare that they would guarantee 3 per cent.

Mr. Johnson: It is possible it is so now, but instructions have not been issued up this way to that extent.

Mr. Browne: If it does not exceed 10 per cent. it goes without saying that we must use the storage battery. I have had in mind for some considerable time the utilization of the storage battery in connection with our station. I know the experience with it in



MR. JOHN YULE,
President Canadian Electrical Association.

New York is that it is satisfactory. The only element which is uncertain is as to the fixed amount of repair in operation.

Mr. F. C. Armstrong: The field for the storage battery is unfortunately confined to direct current work. How would you get over that difficulty, Mr. Browne?

Mr. Browne: My way of using it is by operating a direct current machine and charging my battery, and in return operating a motor to drive an alternator. I am calculating on having an efficiency of 50 per cent. from the plant. I believe I can afford to do it.

Mr. Johnson: I might say that there is no doubt there are a number of cases where alternating current dynamos are operated by water power some distance from towns or cities where the current might be delivered through the city and rectifiers used to charge the batteries or rotary transformers, and the capacity of the generating plant and the transmission line be kept down. The distribution could be handled fully as easily, perhaps, with the same generators as through the usual alternating circuits; that would apply especially to a water power that was not extremely large.

The President: It has been moved by Mr. Hunt, seconded by Mr. Farley, that a hearty vote of thanks be tendered to Mr. Johnson for his paper. Carried.

The President: The paper by Mr. Keeley on "Economy in Circuits" will have to be taken as read. (See page 120.) It will appear in the report of the proceedings of the convention.

A vote of thanks was tendered to Mr. Wilfred Phillips for his untiring and valuable efforts for the success of the convention, and for the complete arrangements made for the entertainment of the delegates.

Votes of thanks were also tendered to the press for the accurate reports of the proceedings of the convention, and to the following for courtesies extended: Niagara Falls Park and River Railway Company; Buffalo and Niagara Falls Electric Railway Company; Buffalo Railway Company; Suspension Bridge Company;

Niagara Navigation Company; Captain Carter; Niagara Falls and Suspension Bridge Railway Company; Niagara Power Company, and Hydraulic Power and Mfg. Company.

Adjournment was then announced by the President.

SOCIAL FEATURES.

On Wednesday morning an excursion to Buffalo took place, which was well attended. Great interest attached to the inspection of the power station of the Buffalo Railway Co.

The annual banquet was held on Thursday evening at the Dufferin Cafe, and was a marked success. About 125 members and their friends were present. Mr. John Yule presided. Letters of regret were read from Hon. A. S. Hardy, premier of Ontario; Hon. J. M. Gibson, Commissioner of Crown Lands, and several others. After Her Majesty had been duly honored,



MR. C. B. HUNT,
First Vice-President Canadian Electrical Association.

responses were made to the various toasts as follows: "Our Guests," Mr. Wilson, of the Queen Victoria Niagara Falls Park Commission, Mr. Lincoln, of the Cataract Construction Co., and Mr. Innes, of the Guelph Light and Power Co.; "Electrical Industries," Messrs. W. H. Browne and H. P. Dwight; "The Ladies," Mr. F. C. Armstrong; "The Press," Mr. W. Johnston, of the Electrical World; "The Mayor of Niagara Falls," Mr. Cole; "The Presiding Officer," Mr. John Yule.

The closing day was devoted entirely to sight-seeing. Starting at the Hotel Lafayette, the party were conveyed by the Niagara Falls Park and River Railway to "Rapid Views," Brock's monument, and Queenston. Crossing the river to Lewiston, a trip was made on the gorge railway. A visit was also made during the day to the power houses and works of the Cataract



MR. J. A. KAMMERER,
Second Vice-President Canadian Electrical Association.

Power and Construction Company and the Niagara Falls Hydraulic and Power Manufacturing Company, and the expedition wound up by a trip on the Maid of the Mist.

Amongst the visitors to the recent convention of the Canadian Electrical Association at Niagara Falls, was Mr. William McCulloch, formerly with the Canadian General Electric Company, now the representative of Mr. Hugo Reisinger, 38 Beaver street, New York, who is the American agent and importer of "Electra" carbons, manufactured at Nuernberg, Germany. These goods will be on sale in Canada by the Canadian General Electric Company, and Mr. McCulloch hopes to establish quite a business in this country. These carbons do not come in competition with American or Canadian made goods.

WHY SOME LIGHTING PLANTS DO NOT PAY.

By F. C. ARMSTRONG.

BEFORE proceeding to a discussion of the subject proper of this paper, it is necessary to fix a standard by which it may be determined whether a given plant is paying or not. A fair definition taking everything into consideration would seem to be that a plant which earns twelve per cent. per annum or over on the capital investment, which at present prices of apparatus and material would be required to provide an equipment of equivalent earning power, should be considered as a paying investment. In this definition we imply that 6 per cent. net per annum is a fair return for money invested in an enterprise of this nature; that 6 per cent. per annum is under present and prospective conditions a reasonable and sufficient allowance for depreciation; and that the capitalization upon which these charges are made should suffer the material and arbitrary reduction necessary to bring it down to the basis of present selling prices of electrical equipment. Regarding the first of these postulates a strongly affirmative view may be taken. Electric lighting has established a reason for being beyond question, amongst modern industrial enterprises. Abundant artificial illumination for safety, need or convenience has become an indispensable requirement of our present multiplex civilization. The electric light supplies this necessity, it is safe to say, in spite of Welsbach burners or acetylene gas, more completely than any present or as far as we can see any possible competitor. The central station is a shining example of the sound economic principle of concentration of production and diffusion of output which means commercially that under most circumstances it is cheaper to get your light from a central station than to install an isolated plant. It may, therefore, fairly be thought be conceded that, whatever may have been the vicissitudes of the past, the money invested in a central station to-day is entitled to take rank as a safe conservative and first-class investment from which a return of 6 per cent. per annum should be regarded with satisfaction.

The sufficiency of the allowance of 6 per cent. to cover depreciation is more open to discussion and in it is really involved as well, the soundness of the third assumption. In order to clear the way to a fair consideration of this matter it must be kept in mind that the depreciation of electrical apparatus in the past, and to a measurable degree in the future, is of two distinct kinds. The first is in the depreciation proper, due to the wearing out of the machinery and appliances in service; the second, and in the early days of the electrical art vastly the most important is the arbitrary depreciation which is due not to the wearing out of the plant but to its becoming obsolete by reason of the introduction of newer and more efficient and satisfactory types. There can be no question but that the unparalleled rapidity of development of electrical science and the electrical industry which has crowded the progress of a century within one decade and a half, has borne heavily upon the earlier investors whose faith and courage made this marvellous progress possible. The apparatus produced in the tentative stages of electrical evolution was naturally crude and often unsuitable for the purpose for which it was sold, since the principles governing its operation were only dimly understood or guessed at, and that often incorrectly. Considered in the light of present standards, the units in use were, in view of subsequent requirements, absurdly small; the commercial efficiency of generators, distribution lines and transformers when used was very low; regulation, with all which it entails in plant efficiency, was practically non-existent. The steam plant on the market too was in a much less advanced stage of development than at present, and the relative suitability of varying types had as yet to be determined. Contrasting with this the present condition of the art, we find that in the best types but little room is left for improvement along present lines. The efficiency of the best dynamos to-day is exceedingly high, 90 per cent. or better at full load being an ordinary guarantee for even the smaller sizes. Regulation in the best ma-

chines, both for incandescent and arc lighting, is practically perfect. As an example of the stability to which the highest grades of apparatus have attained by a gradual course of evolution, we may instance a widely-known machine—the ironclad armature type of alternator, as constructed by a number of the principal manufacturing companies. Experience has established its perfect adaptation to the purpose for which it is primarily intended—the supply of alternating currents for incandescent lighting. Its design renders possible the highest attainable efficiency at all loads; the regulation by the simple device of compounding provides compensation not only for armature reaction, but also for line and transformer drop, ensuring an even potential at the lamps, and permitting the use of lamps of ten, twenty, or thirty per cent. higher efficiency than was possible with hand regulation. The ironclad construction of the armature secures perfect mechanical protection of the conductors buried in the slots, and these are made easily removable for repairs in case of damage. The high self-induction caused by burying the coils beneath the iron of the armature affords the best possible protection against burn-outs by lighting or short circuit. The single phase system for which these machines are designed is admittedly the simplest and most economical for lighting distribution. Altogether, therefore, it is evident that this machine, which is selected simply as a familiar type, has proved itself in experience to be admirably adapted for the work which it is called on to perform.

Setting aside all unessential peculiarities in design, by which one or another machine or appliance may be recommended as against that of a competing manufacturer, there can be no question that for both incandescent and arc lighting the best types to-day are practically perfected for the work which they are called on to do, and have therefore reached a reasonably permanent and stable form. This being the case, the arbitrary depreciation charges to which an investment in electric lighting plant was formerly subjected are no longer to be feared, and that the depreciation due to the natural wearing out of the machinery in service is covered by the allowance made for that purpose, no one will probably be inclined to dispute. In the matter of current prices, whilst improved methods of manufacturing and the keenness of competition may be expected to cause from time to time some further reductions, the bottom may fairly be said to have been touched in most lines of standard supplies and machinery.

Involved in the foregoing, at least by inference, is of course the conclusion that the wasted capital represented in the balance sheets of most companies by obsolete and discarded plant bought at the high prices of the early days should be wiped out; if not by the summary process of reduction in capital stock, at any rate in so far as it affects a reasonable and just decision as to the profitable nature of the field offered by electric lighting under the conditions which obtain to-day.

Having thus defined the standard by which we may judge whether a lighting plant pays, we may now indicate briefly some of the causes of failure to realize the modest basis of earning power which we have set forth, and which is the very lowest which can be regarded as satisfactory. The matter is too large for proper treatment within the limits of a convention paper, even with its scope restricted by leaving entirely out of consideration the central stations of the larger cities. I shall therefore only attempt to suggest by touching very generally on some of the more evident causes and causes of failure, a set of conditions the real root and remedy for which will be apparent to the experience of the members of this Association.

The subject naturally divides itself into two sections, the one, failure by reason of mistakes in management and business methods; the other, failure through mistakes in engineering and the actual operation of the plant itself. In the first, a sufficient cause for the non-success of the enterprise is often found in the personnel of the management. In this respect central stations are of five classes: the first, those which are in charge of a manager or superintendent who may be specially trained for the work, and who devotes his attention ex-

clusively to it; in the second place, those whose management is in the hands of a man who divides his time between it and his other business interests; the next is the large class of small stations which manage themselves, with occasional interference on part of the owner; in the fourth place, and I say it with due deference, we have the lighting stations which are run as appendages to a gas plant, by a gas manager, and which, treated with the care and indulgence which falls to the lot of a necessary evil, make precisely the return on the investment which might be expected. There are notable and happy exceptions, but I regret to say that the rule with this class of station is as I have stated. Finally we have that Ishmael amongst lighting stations, which its enemies say always, and its exponents say never, comes under the caption of this paper. I mean the municipal plant. In it we have quite often an ingenious combination of all possible methods of mismanagement.

Speaking generally on this point, it will, I think, be admitted that there is to-day no industry representing an equivalent money investment, and possibility of public service, which is so generally managed by men who know little or nothing about it. But the special knowledge and training which comes with experience is in a new business not readily obtainable. The ideal manager will come with time; some of him is here to-day.

The electric light is a manufactured commodity offered for sale to the public; for it there exists in each community, a certain possible maximum sale; and with it to a greater degree than with most other manufactured products, the cost of production per unit is reduced as the output is increased. The question of rates is therefore an all-important one in deciding the earning power of an electric lighting plant. I will venture the assertion that in most flagrant cases of plants which positively refuse to show any margin on the right side between gross revenue and operating expense, the remedy lies in cutting down the rates to the point which will force a large increase in the business. A plant which supplies 200 lights at \$10 each per annum has a revenue of \$2,000 per annum and may not pay; the same plant, if increased to 1,000 lights at \$5 per annum would probably be paying handsomely.

It is evident also that, like the telephone, central station electric lighting is a natural, and when conducted upon proper lines, a beneficial monopoly. The supply of current for lighting and power within a certain area can unquestionably be carried on more economically from one than from two or more competing stations. The benefits of such economical production may be shared alike by producer and consumer. When such is the case the security for the investment rests on the soundest possible basis, the rates being brought low enough to realize the fullest development of the business within the prescribed limits, the satisfaction of the public being ensured, and plainly no opening for profitable competition being left in dividing up a business which, even when extended to the utmost limits, and therefore carried on under the most favorable conditions, affords only a reasonable profit on the money invested.

In connection with rates and the field for business, the arc light contract properly comes up for consideration. Its value now-a-days to the average station is very doubtful. The development of the incandescent lighting, and more lately the power business, has established a reasonably secure and permanent market for the output of the central station, and to this fact more than any other are due the improved conditions now noticeable in the industry. It is unfortunately true that a large proportion of the existing investment is in many cases represented by dynamos, lamps, poles, lines, etc., which are valueless except for the purposes of the street lighting contract, but even under these circumstances it would in most cases pay the lighting company far better to devote their energy and plant capacity to a development of their proper and permanent business, adding whatever new capital may be necessary to properly equip them for the purpose, rather than continue their profitless and uncertain tenure of the municipal contract.

Also in connection with rates comes up naturally the

question of a meter or contract basis. We are leaving out of view now, of course, the case of the large city plants. While on the face of it it would seem reasonable that the current for electric lighting should be measured for sale like any other manufactured product, and not sold by bulk and by guess, there is at bottom a sound reason for the instinctive tendency to continue on the contract basis noticeable in many plants. The reason is, though, not always clearly understood that a mere measurement of the number of units taken to supply a customer for a given time is not a fair measure of the cost, and therefore of the selling price of the units supplied to him. This rests on the fact that all units do not cost alike. Those produced at 6 p.m. for example, the period of maximum load, cost far more than those supplied at 11, in the main and governing item of charge per unit from capital investment. Accordingly the meter measurement of quantity is not a measurement of value or cost, but only an approximation to them upon an erroneous basis. To meet this discrepancy it has been proposed to install two or more meters to measure current taken at heavy and light load periods of the plant, a larger discount being given for the latter. The basis of contract rates which is general throughout Ontario really represents this condition fairly well, the shop and business rates being relatively high, and the residence rates low considering the number of units actually supplied in each case. At the same time it must be recognized that in all cases with the larger, and quite frequently with the smaller plants, especially those supplying a day service, the meter method becomes imperative as being the only method whereby a check can be kept on the consumer for actual lighting supplied. In all cases where meters are used a meter rental should be charged, and a minimum monthly charge for each lamp installed provided for in the contract. Otherwise we frequently find a large part of the lamps connected to a central station, to provide for which a continuous charge on account of capital is going on, returning nothing whatever in the way of earnings for months at a time, and then coming in for the most favored customer treatment of the largest consumer.

Another point in connection with the relationship of the central station and the customer is the basis upon which wiring of consumers' premises is done. The vicious principle of free wiring has been practically frowned out of existence, but one equally mischievous has in some instances taken its place—that the wiring department should be conducted at a handsome profit. The correct principle is, of course, to give the customer for your current the fullest benefit of the present low prices for all interior wiring supplies in order that more and more lamps may be installed and the profits obtained in a legitimate and permanent form.

There are a number of additional matters which might be touched upon in considering this side of our subject, such as the effect of the competition of coal oil, gas and Welsbach burners; the recent governmental regulations and certain desirable extensions of the same, and so on. Not the least important of these, in view of the certain benefits to be derived, is the building up of this Association into a strong and compact organization, able on the one hand to protect the industry in which its members are engaged from the attacks of conflicting interests or of ignorant and harmful legislation, and on the other hand by a frank interchange of experience and opinion to assist in hastening the day when Progress and Profit shall be the happy watchword in all cases describing the conditions of central station operation.

It was intended, had space permitted, to discuss the subject of this paper from the other standpoint which has been mentioned—that of engineering and operation, taking up first the question of selection of apparatus which would give the ideal plant for each set of conditions, and considering in how far deviations from such an ideal installation were responsible for failure to get best results in a given case. Such a consideration of the matter, however inadequate in itself could not fail to bring out points in discussion which, checked by the actual experience of the managers of central stations present, would become of the utmost value.

DETERMINATION OF THE HEATING POWER AND STEAM-PRODUCING VALUE OF COALS FROM A PRELIMINARY EXAMINATION.

By WILLIAM THOMPSON, Montreal West.

THE choice of a subject for a paper to be placed for discussion before an Association composed of gentlemen so eminently fitted for their profession as are the members of the Canadian Electrical Association, becomes a matter of more than ordinary importance.

In choosing my subject I was first guided by the request of your committee that my paper should be along the line of "Chemistry in the Boiler Room," and the fact that the members of this Association are gentlemen who hold responsible positions and in many cases are central station managers, and as such, more than ordinarily interested in subjects pertaining to economical management.

We cannot all of us have such magnificent water powers as we see here and elsewhere throughout the Dominion of Canada, and consequently have to go to the coal pile as our source of power.

A successful station manager takes pride in choosing his generating and distributing apparatus with the greatest possible care, and purchases only that which he considers suitable for his purpose. We all know that there is efficient and inefficient station apparatus, and we all strive to get as far as possible that which we consider will bring us in the greatest return and most efficient service for capital invested. The same principle of getting best returns and most efficient service should, I claim, underlie our system of purchasing our fuel.

It is not my intention to discuss the merits or demerits of any particular variety of coal, but to try to establish a method whereby the heating power, and consequently, the value of any fuel, can readily be determined, and when the knowledge of conditions under which combustion must take place are understood, we shall, in some measure at least, be able to intelligently choose between any number of samples and varieties of coals that are most suited to our purpose.

Undoubtedly the most scientific and correct method of determining the actual heating power of any substance is by the aid of the calorimeter, but when we consider the high cost and delicate manipulation required in an instrument of this kind, we find it is practically debarred from use except by the expert chemist in his laboratory.

Repeated efforts have been made by scientists to construct a formula whereby the actual heating power of coals could be accurately ascertained by computation. Perhaps the most recent and nearest correct formula of this kind that has been given to the public is the formula constructed by Dulong, and more recently by Mahler.

Both these gentlemen based their calculation upon an elementary analysis of the coal under examination, and they both seem to agree upon the fact that the heating powers of coals of a like composition remained constant, and that the heating power of coal changes as the composition changes. They also establish the fact that the heating power of fixed carbon remains constant, as does also that of hydrogen when in combination with the same proportions of oxygen and nitrogen.

Dulong accepts as the heat-producing elements of coal carbon and hydrogen, giving each a constant calorific value, and at the same time determined that the oxygen of the coal renders unavailable for heating purposes one-eighth of its own weight of the hydrogen, and on this basis constructs the following formula:

$$Q = 14,544 C + 62,100 (H - O_8)$$

which for convenience might be written:

$$Q = 14,544 C + 62,100 H - 7,762.5 O$$

Where Q equals calorific value of fuel,

$$\begin{aligned} 14,544 &= \text{constant heating power of carbon} \\ 62,100 &= \text{ " " " hydrogen} \\ 7,762.5 &= \text{ " neutralizing power of oxygen} \end{aligned}$$

Mahler, at more recent date, and after a series of lengthy experiments, amended Dulong's formula slightly by accepting Berthelet's more recent determination of the heating power of carbon as 14,652 B.T.U., and using

the empirical constant, 5,400, at the same time taking note of the effect of nitrogen as well as that of the oxygen. Mahler's formula then became:

$$Q = 14,652 C + 62,100 H - 5,400 (O + N)$$

Where Q equals calorific value of coal,

$$\begin{aligned} 14,652 &= \text{constant value of carbon} \\ 62,100 &= \text{ " " " hydrogen} \\ 5,400 &= \text{ " neutralizing effect of oxygen, less} \\ &\quad \text{heat formed by formation of nitric acid,} \\ &\quad (N O_2 + H_2 O) \text{ (Note 1.)} \end{aligned}$$

On comparing these formulae with a long series of actual calorimetric tests made by Mahler, it is surprising how near either of these laws come to the actual theoretical value of the fuel.

To engineers, however, a new difficulty here presents itself, since both of these formulas are based upon an elementary analysis, which is not only difficult to make, but exceedingly liable to give an inaccurate result, unless conducted by a chemist, experienced in this class of work. Consequently we must look for a formula, constructed on the basis of a proximate analysis.

It is for the sake of clearness necessary for me here to explain the difference between an "elementary" and a "proximate" analysis, and also what the term of "fixed carbon" means. An elementary analysis of coal is a definition used when it is understood that the whole of the elements composing the coal are determined and separately enumerated. A proximate analysis determines the coals into four sections, and consists of the determination of moisture, volatile combustible matter, fixed carbon, and ash.

The volatile combustible may consist of several elements, but is chiefly composed of carbon and hydrogen in combination as "hydro-carbons." This carbon is hereafter usually referred to as volatile carbon, and the carbon remaining in the free or solid state is referred to as fixed carbon. For example, the coke from gas works contains fixed carbon plus ash.

M. E. Goutal appreciated this difficulty referred to, and after reviewing the work of Mahler and others, made a number of calorimetric tests, comparing them with a formula of his own construction, and published in *Progressive Age*, Jan. 15, 1897, as follows:

$$Q = 14,670 F.C. + A \times \text{volatile matter,} \\ \text{when } Q = \text{calorific value of coal.}$$

14,670 = constant heating power of fixed carbon,

A = 23,400 when volatile matter equals from 2% to 15% of total combustible.

A = 18,000 when volatile matter equals from 15 to 30% of total combustible,

A = 17,100 when volatile matter equals from 30 to 35% of total combustible,

A = 16,200 when volatile matter equals from 35% to 40% of total combustible.

The result of this formula seems to come as near the actual theoretical value of coals, as anything it has been my privilege to consider, and may at the present time be taken as a useful formula for the calorimetric value from a proximate analysis of coals of an anthracite, semi-bituminous and bituminous nature, but should not be used in cases where the volatile matter exceeds 35% of total combustible, as it gives results altogether too high in samples of extra hydrogenous or lignitic coals.

Up to this point I have dealt entirely with the estimation of the actual calorimetric value of coals. This, however, does not give us the information we require as engineers. Experience teaches us that there is often a wide difference between the industrial value of bituminous and anthracite coals, owing apparently to the increased percentage of volatile matter in bituminous varieties. A review of Mahler's calorimetric tests shows the interesting fact that the total calorimetric value of coals vary but little, and that a decrease of fixed carbon does not reduce the heating power of the coal in proportion to the increase of volatile combustible matter, while on the other hand repeated tests prove that the industrial value of coals de-

(Note 1) $N_2 O_2 + H_2 O = 2 H N O_2$. The calorific value of 1 lb. nitric acid equals 187.79 B.T.U.

creases almost in the same proportion that volatile combustible increases. The extensive tests of European coals made by Schurer-Kestner in 1868, and afterwards collated by Mons Gruner, gives us most interesting and valuable information on this point.

For industrial purposes Gruner divided these coals into five distinct classes, according to the quantity of fixed carbon contained in the combustible of each.

Class 1: When the total combustible of the coal was composed of 50-60 fixed carbon.

Class 2: 60-68 fixed carbon.

Class 3: 68-74 " "

Class 4: 74-82 " "

Class 5: 82-95 " "

Taking the lowest of each of these classes, he gives the elementary analysis and percentage of total combustible in each class as follows:

TABLE OF INDUSTRIAL VALUE OF COALS,
as per Gruner's classification.

CLASS	Fixed Carbon, Total Comb.	Volatile Carbon Total Comb.	Hydrogen, Total Comb.	Oxygen and Nitrogen, Total Comb.	Actual Value in B. T. U.	Industrial Value in B. T. U.	Industrial Value, % of Actual
5	82	8	4.5	8.5	16,350	10,368	69.6
4	74	14	5.5	6.5	16,740	10,596	63.3
3	68	16	6.0	11	15,840	9,756	61.
2	60	20	6.5	14.2	15,300	8,756	57.2
1	50	22	8.5	19.5	14,400	7,716	53.6

We can safely take it as an established fact that the heating power of fixed carbon will remain constant. The same can be said of hydrogen in the absence of oxygen in the combustible, and the heating value of the hydrogen in the combustible will decrease in proportion to the increased percentage of oxygen within the combustible. Both Dulong and Mahler recognize this fact, and construct their formula accordingly. It will be observed that both the calorimetric and industrial value of Gruner's class 4 is higher than class 5, although the percentage of fixed carbon has decreased 8%. The industrial heating value, however, has not increased in proportion to the increase of hydrogen in the fuel, while actual heating value by calorimeter fully accounts for such an increase. Although the difference is but slight in this particular case, it points to a very significant fact, which is more clearly exemplified in the following three samples of coal; that is, that the actual calorific value of coals decreases in nearly the same proportion as the neutralizing effect of the oxygen on the hydrogen increases, and that the industrial heating value of the coals under the boiler decreases as the proportion of volatile carbon increases.

We have this strongly exemplified in our daily practice. It requires but ordinary observation for us to readily see that anthracite coals produce practically no smoke, semi-bituminous coals very little, while bituminous coals produce dense, black clouds of smoke varying in density and volume according to the quantity and composition of the volatile combustible matter in our fuel. An examination of the sooty deposit formed by the condensation of the smoky products proves it to be largely composed of minute particles of carbon which is combustible, proving to us pretty conclusively that the cause of the decrease in industrial heating value is loss of heat from the carbon of our coal, due to the extremely volatile nature of the carbon in combination with hydrogen as hydro-carbons.

It has been said that the industrial value of a coal for steam-making purposes is practically fixed by the percentage of fixed carbon in the fuel. A review and close examination of Gruner's tables of the results of tests on European coals, and verified as being practically correct by similar tests made by Johnston on American coals at a more recent date, shows us we cannot take this method of determination as a permanent basis for calculation with any degree of accuracy. In Gruner's anthracite class 5, industrial heating value of coal only equals 83.3% of the heating value of the fixed carbon, with Berthelot's determination as a standard.

In semi-bituminous class 4, industrial value equals 97.7% of heating value of fixed carbon; in bituminous

classes 2 and 3, 97.1% and 99.6%—showing us that if we undertake to fix industrial value of coals without reference to volatile combustible matter, we are liable to rate value of anthracite varieties too high.

Bearing in mind these facts relative to the heating value of the volatile combustible, it becomes markedly difficult to construct a formula applicable to a proximate analysis.

It has been established fairly satisfactorily, however, that volatile matter of similar composition will give off like quantities of heat. Mr. Goutal kept this fact prominently before him, as also the fact relating to fixed carbon, and consequently gives in his formula a series of constants for the determination of the heating power of the volatile combustible. While these constants might be improved upon by division into shorter sections, the results are nevertheless near enough the theoretical value for ordinary purposes.

The adoption of the principles underlying Goutal's formula, and multiplying by the average percentage of efficiency of the various classes of coals for industrial steam-making purposes as determined by Schurer-Kestner on European coals and Johnston on American coals, leads me to the belief that a formula constructed as follows will be of especial benefit in enabling engineers to arrive at the steam-making capacity of their coals:

$Q = 14,652 \text{ f.c.} + A \times \text{volatile matter} \times B$,
Where A equals 23,400 when volatile combustible is equal to from 2% to 15% of total combustible,
A equals 20,000 when volatile combustible equals from 15-30% of total combustible,
A equals 17,100 when volatile combustible equals from 30-35% of total combustible,
A equals 16,200 when volatile combustible equals from 35-40% of total combustible.

Where Q equals industrial value of coal for steam-making purposes, and where

B equals .64 when fixed carbon equals 82-90% of total combustible,
B equals .65 when fixed carbon equals 74-82% of total combustible,
B equals .662 when fixed carbon equals 68-74% of total combustible,
B equals .588 when fixed carbon equals 60-68% of total combustible,
B equals .551 when fixed carbon equals 50-60% of total combustible.

In reviewing this formula I may say I was guided in its construction by the fact that the heating value of the volatile combustible is a constantly changing quantity, but remains constant in accordance with its composition of the elements, and that these elements occur in practically fixed proportions, determined by the total volatile combustible matter in the coal.

With this formula and the proximate analysis before us, we are readily enabled to determine, which of two coals are likely to be the most economical and best suited to the conditions under which combustion must take place, and will, I hope, be found useful by my hearers in enabling them to arrive at the real value of any sample of coal placed before them for their examination and opinion.

ECONOMY IN CIRCUITS.

By D. H. KEELEY.

The design of the diagrams presented hereunder is to establish the fact that, without exceeding the weight of copper, or the drop of E. M. F. in current transmission, found in a single parallel system, it is possible to provide for distribution with an equalized pressure at all points.

This diagram (Fig. 1) represents a transformer delivering 52 Volts with a primary resistance of .05 Ohm.

Current is supplied to 17 lamps, each taking normally 1 Ampere, and located in groups equidistantly—two of them at the terminus of the transformer.

The mains are of such size as presents a resistance of .05 Ohm per 1000 feet.

The total drop, it will be seen, is $.85 + .375 + .125 + .125 + .375 = 1.85$ Volts. The difference of potential is 2 per cent. less at the terminal group than it is at the transformer; being, as it figures out according to the drop, $52 - .85 = 51.15$ Volts between A and A1; $52 - 1.60 = 50.40$ Volts between Band B1, and $52 - 1.85 = 50.15$ Volts between C and C1.

This diagram (Fig 2) represents two transformers of half the size and capacity of the one shown in the preceding figure, each delivering 52

Volts with a primary resistance of .1 Ohm. The number of lamps and their locations are the same as before, the mains in this instance, like the transformers, are half the size of those shown in Fig. 1 and present a resistance of .1 Ohm per 1000 feet.

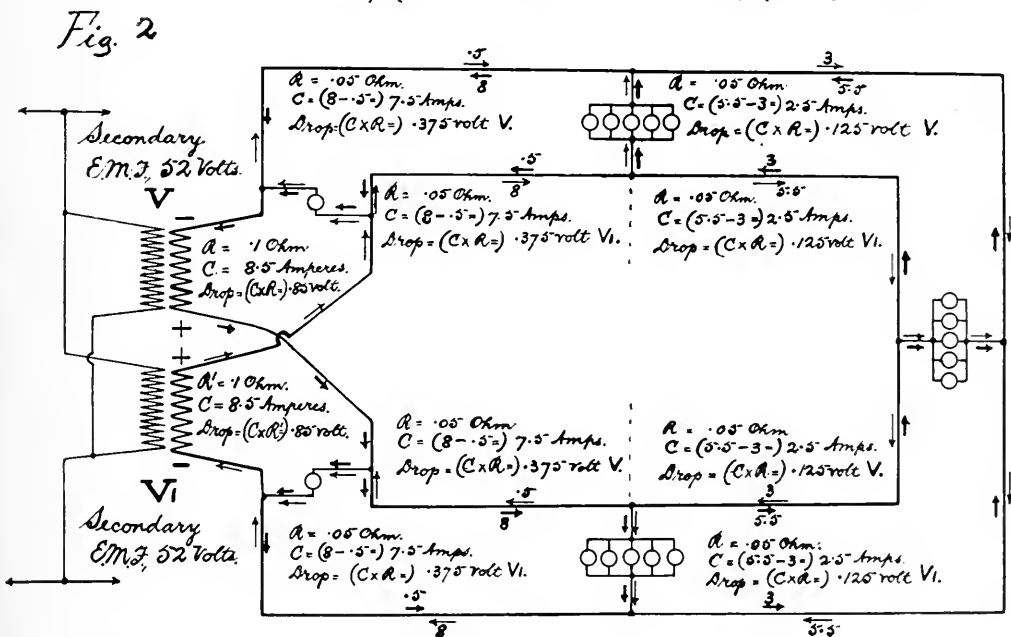
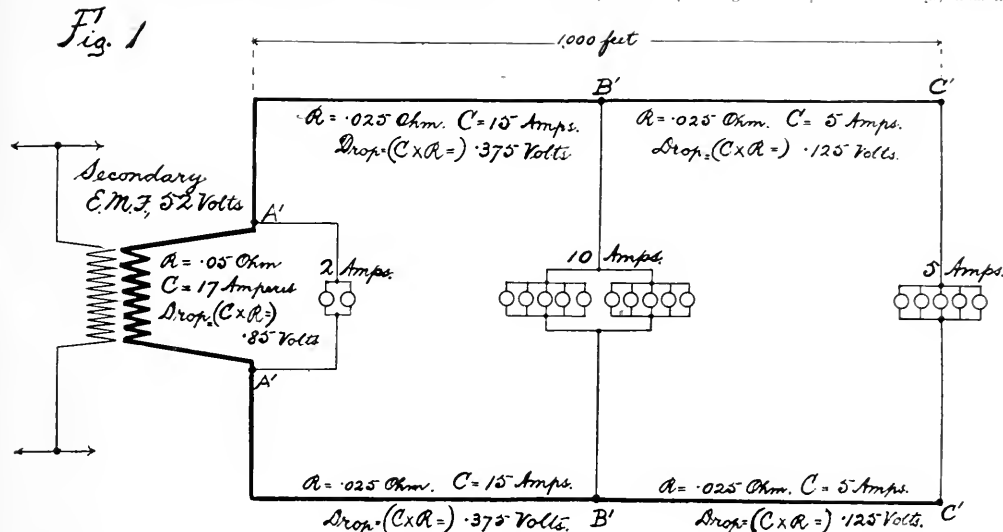
PHILOSOPHY OF FIG. 2.

In a circuit supplied with E. M. F. from more than one source, the current developed at objective points is proportionately contributed to from the several sources of the E. M. F.

Following the above, the amperage of the circuit is halved between the transformers V and V₁. To simplify matters, the courses of the currents ordinarily obtaining are indicated by arrows; V heavy and V₁

The author's apology, if any is needed, for bringing this matter again to the notice of the members of this Association is that it might perhaps happen that a good thing was being lost sight of because of its not having been presented in a sufficiently clear manner to secure its recognition on a former occasion when it was dealt with under a different title. The circumstance that at the Ottawa Convention a paper was submitted by the author which in subsequent published comments was stated to have explained a demonstrable but somewhat abstruse fact in a new and clear way, will perhaps justify a renewed effort in regard to the present subject.

The importance of providing for an equal distribution 'is, from the



Distance from sources V V₁ to terminal group 1000 feet.
The other groups occur midway.

light, running from + to - in each case. It will be seen that where they are opposed, the difference between the two represents the amperage obtaining. The allotment of absorption is traced accordingly. On the whole the distribution of the applied E. M. F. is the same as if the circuits of V and V₁ separately ended at the terminal group 5 A. The total drop, it will be seen, is .85 + .375 + .125 + .125 + .375 = 1.85 Volts in V for half the amperage; and the same in V₁ = in all 1.85 Volts for the 17 amperes—the pressure or potential difference under these changed conditions being the same at all points since the same total drop of 1.85 Volts is found along the mains between the transformers and each of the several groups.

writer's point of view at any rate, secondary to nothing in the electrical field. Perhaps reference may be allowed to an editorial on page 151 of the September, 1895, number of the Canadian Electrical News in which the question of economical supply is dealt with. The author of that article prefaces the whole with the observation that

"It is of great importance to electric lighting systems that the pressure all over the system should be sensibly the same, and equal at all loads."

We are all, of course, prepared to grant this proposition as a whole—whence it follows, the conditions requisite to the end had in view should be enquired into. In the first place it will be seen the requirement, though taken "altogether" in the above quotation, is of a two-fold

character. The need for equalization of pressure throughout a system of supply is one thing, and the need for a uniform pressure under all loads is another thing. The one hinges on the other, however, and so long as one department remains undeveloped the other cannot be brought to make up for the deficiency.

Now it is the first mentioned feature of this proposition—the need for equalization of pressure throughout a system—that has been dealt with in the present paper. In the other department—covering the need for a uniform pressure under all loads—we are presented with a problem that so far seems to have been grappled with from behind the dynamo or by the introduction of boosting devices effecting changes of pressure in the mains. As it happens, however, that these changes are made in the circuit as a whole without any particular reference to individual transformer (or lamp group) requirements, it follows that near-by points are given an excessive pressure when the increased demand arises further off; so that at any time in their operation these methods only operate to maintain a uniform pressure at a given point of the system, and a general uniformity of pressure cannot be obtained by these means alone. The main thing, then, is to secure equal distribution; that being provided, the means already found for regulating the pressure will fall handily into line; and the whole object aimed at will be as nearly attained as may be, pending the evolution of something less clumsy and perhaps automatic, regulating the output of the dynamo.

In conclusion, the point aimed at will bear a little further exposition. In a system of circuits arranged to supply an equal potential difference at all points, it will be found the drop between the source of E. M. F. and the points of consumption is the same in every instance.

As regards the leads then, the absorption of the transmitted E. M. F. amounts to the same total quantity, no matter from what point it is calculated. Hence, when an increased demand arises at any point, the absorption in the mains becomes correspondingly increased in all parts; and when the initial pressure is increased it similarly takes to all parts, thus evenly compensating for the increased absorption and presenting no increase of P. D. at any one point more than another, and in no case higher than may be predetermined or desired.

Moreover, in any such system of circuits a lamp (if the supply is a direct one), or a small transformer operating a lamp (if the supply is in that way conveyed) may be located in the supply station, and it will burn with the same current at the same pressure as any other lamp in the system though this latter extends for miles.

And this it seems can be realized, as demonstrated in the diagrams, without exceeding the weight of copper that is now used in the two-wire or simple parallel system, and at the same time without involving any further drop of the applied voltage than obtains in that two-wire system.

One word more. When we will have arrived at that stage where the pressure in the mains can be kept at something in excess of the demand, while at the points of consumption only so much current is drawn off as there is a demand for, we will have attained perfection. The whole thing will then be automatic. But, in such a system it is obvious an arrangement of circuits operating as described in this paper will be altogether indispensable, so we will have now made much of an advance towards that era.

THE COMMERCIAL ASPECT OF ELECTRIC RAILWAYS.

By C. E. A. CARR.

THE subject of my paper "The Commercial Aspect of Electric Railways" is a question that has engaged the thought of the ablest men for years, and in presenting this paper, I do not presume to know more than my fellow creatures, nor to have discovered any special facts that give a satisfactory answer, but merely give you a few chapters from my own experience and observation.

This is not the time nor the place to discuss the best method for the collection of fares, whether to use a rigid or flexible bond, or whether a single or double track is best, although these details require a great deal of study, and I leave a close relation to the answer to my subject.

Electric railways on this Continent are usually built by a company authorized to do so by special Provincial or State legislation, and the opposition so generally met with in obtaining these special powers, is but a pleasant (if introduction to the later difficulties to be met with in securing from the various City and County Councils the rights to lay down rails and run the cars. Having secured a charter and obtained agreements from these various Councils, the real work of railroad building begins, and as to what are the best methods of construction, equipment, and operation to make it a success, will be the leading thought of this paper.

Track construction is a subject that has been thoroughly discussed from time to time, and as so many Engineers differ as to the best methods, I can only express my opinion as to what forms are best suited under certain conditions. For an electric road in a town or city street, or wherever pavements of a permanent character are used, the trolley rail seems to be the only one suitable. The depth of the rail should be not less than 7 in. and should weigh from 70 to 90 pounds to the yard. What the exact weight of the rail should be, would depend upon the frequency of the service required, and the weight of the rolling stock to be used. In a macadam or unpaved roadway, a T rail of 65 pounds to the yard is all that is necessary. While it may be better, under certain conditions to have rails laid in concrete with a permanent pavement, my experience has been that cars rattle and jar a great deal more than when running over a road-bed of less rigidity. In all paved streets, rails should be firmly spiked on oak ties 5 in. x 7 in. x 7 feet, spaced 2 feet apart. The grade should first be properly levelled, and the whole surface covered with good coarse gravel 6 in. in depth. Fish plates or angle bars 3 feet long, with not less than 6 bolts at each rail joint, should be properly fitted and bolted. Soft copper bonds of sufficient size to carry the maximum return current from any distant part of the line to the power house, should be properly attached at each joint.

Many improvements have been made in overhead line materials during the last couple of years, so that to-day there are several manufacturers of very satisfactory supplies.

The trolley should be carried with a straight line hanger thoroughly

insulated and attached to a flexible bracket or span wire. A sufficient number of feeder lines should be used to maintain the voltage under a maximum load, and section switches, emergency breakers and lightning arresters should be placed at frequent intervals, and where a number of lines constitute one system, trolley brakes with each feeder section.

The rolling stock should be the best obtainable, and for city traffic, mounted on single track with wheel base not more than 7' 6". Seats should be fixed crosswise of the car, and the doors and aisle so arranged as to permit of easy and speedy exit. For a high speed suburban road, a car 40' long mounted on double track, is more desirable, but as so many companies, operating city lines, make long extensions to some suburban town or pleasure park, the city cars are usually called upon to do service. All passenger cars should be well lighted, fitted with signal bells, curtains, and properly heated during the winter season. Keep the cars clean inside and out, and upon the first appearance of dowdiness, have them overhauled, repainted and varnished. The appearance of a car is next in importance to the appearance of employees, and very often indicates the prosperity or otherwise of a railway, as the ever exacting public is not slow to give its verdict.

The power house of an electric railway, should, like the cars, be the best obtainable. It should be built near a railroad track, so that coal can be cheaply delivered, and it is very desirable that the site selected should be near a good water supply, so that condensing engines may be used. If these conditions can be had near the centre of distribution a very great saving can be effected in the cost of copper feeders. The building should be a substantial structure of brick or stone, well lighted and fireproof. Direct connected multipolar generators, with slow speed compound condensing engines, will give best results, where a moderately steady load is maintained. Where few cars are run, and the fluctuation in load varies from three to four hundred per cent. a high speed engine would give better service, as it responds more readily to the varied conditions.

In Canada, where soft coal is used for fuel, the high freight and duty rates, make it essential to have boilers of the highest efficiency, without much regard to their first cost. For this same reason, the boiler room should be fitted with fuel saving appliances, such as an economizer, heater, stoker, automatic damper, regulators, etc., etc.

For an electric railway to be a commercial success depends not only upon the economy and efficiency of its power house, and of the roadway upon which to operate the cars, but "How to make it a Success" is the query that taxes the brain of General Managers and Superintendents throughout the country. How to increase the receipts, without materially increasing the operating expense, are the questions the Directors ask at every meeting.

A certain degree of revenue is the reward of all street railways that run cars up and down the thickly populated streets of any of our larger cities, but is it the success, commercially, it might be? There is an old story told of a toad, that stood on the bank of a brook, with its mouth wide open, waiting contentedly for flies to come to his way. It seems unnecessary to say that the toad died of hunger.

The attitude of many electric railways to-day, is not unlike the unfortunate toad, and while life may be sustained months, perhaps years, death, in the form of the receiver, comes too often.

It is not enough that we carry our regular customers. These come to us anyway, and it is to these that we look for a guarantee of our operating expense. The profit or success of the railway lies in the margin of how many we can induce to become patrons, and thereby increase the regular revenue. This may be accomplished by various means. The railway company, like any other business concern, has goods to sell, in the way of rides, and no doubt there are times in the day when the manager feels that he is overstocked, and is inclined to put on "Bargain Matinees" to get a full car. He should advertise and let the public know there is an electric railway in town; that its business is to carry people from place to place comfortably and quickly, and that they can't afford to walk; that the time saved in riding will more than pay the fare. There are various ways in which to do this, and methods may be adopted so that the cost is very slight.

One very good way is to issue annually a handsomely illustrated booklet, which contains cuts of all the interesting points touched by the cars, briefly telling how to get there. The different firms supplying the company with materials will advertise for the asking, and the cost to the company is practically nil. This style of advertising is particularly valuable to strangers and tourists. The railway company in London issued just such a little booklet as I mention, about a year ago, and it was a daily occurrence to see a group of strangers taking a ride around the Belt Line with book in hand, pointing out the various public buildings, parks and squares, as the car went along.

A specially illuminated car for trolley parties is a profitable source of revenue, and the effect of the colored lights along the line, as the car passes, is very pleasing. It is a good way to advertise, and tends to popularize the service. Many electric railway companies establish parks at the end of one or more of their lines, and provide amusements in the way of band concerts, etc. This brings considerable increased revenue, at a time of the day when cars would otherwise be running light. To what extent a railway company should provide attractions for its patrons, must depend largely upon local conditions. Some companies claim to have profited by this departure, while others have an adverse experience. It is more desirable to have the amusements provided by some one who thoroughly understands it, the company making certain concessions in the way of issuing coupon tickets for admission. In this way, the railway runs no risk and profits pro rata on all increased business.

The selection of employees has more to do with the success of an electric railway than anything else. The idea that anyone can run a street car, has, in many cases, resulted in the employment of incompetent, careless and ignorant men who, through these qualities, have brought the railway into public disfavor. Conductors, motormen, inspectors and shopmen have the power to earn or lose money; make the railway popular or odious with the public; keep claims for damages at a minimum or make them a burden; and very often their selection does not receive the care that it should in the purchase of ordinary supplies. Every employee should be considered an agent of the company, and should not only be sober and intelligent, but have good judgment and a

cheerful disposition. Loyalty to the company he serves, should be his first motto.

With the whole army of employees, loyal, faithful and devoted to their duty, gross earnings will steadily increase and operating expenses be at a minimum, and the stockholders would no longer need to ask if the road was a success.

The growing demand of the public for better accommodation and luxury in the matter of travel and speed, must be met by giving them better cars, more comfortably furnished and more expensively fitted than heretofore. By supplying these demands, the company will add largely to its revenue.

WATER-DRIVEN PLANTS.

By JOHN MURPHY.

THE subject matter of this paper is one particularly suited to the occasion of a convention of members of the Canadian Electrical Association held within a stone's throw of America's greatest cataract, because the operation of water-driven lighting and power plants cannot be even thought of without this mighty force of nature looming up and overshadowing everything else in the lines of mechanical and electrical engineering that have been heretofore attempted.

Remembering what had been done at Niagara towards developing her unrivalled power, it was surely no wonder that the task of dealing with such a subject as the operation of water-driven lighting and power plants was undertaken with a great deal of temerity.

The writer desires it to be remembered that the various water power plants with which he has been connected have been made up of units never exceeding 500 h. p. in capacity, and further, that the head of water was in every case, within his knowledge, between fourteen and twenty-two feet. These facts are mentioned at the outset so that statements made later on will not mislead.

As close regulation is the most important point in the operation of any electrical plant, I will endeavor to show how this can be accomplished best in a water driven plant, and, as so much depends on the manner of installation, I will dwell for a moment on the importance and method of properly equipping the water wheel gate. I take it for granted that the water wheel itself was placed in position by a competent engineer, due provision made to cope with low water, anchor ice and the many other troubles inherent in the use of water power. This having been done the gate and all its connections, from the water wheel to the hand wheel in the dynamo room, should be so constructed as to move quickly, positively and easily. These parts should, as I have just remarked, move quickly, positively and easily, so that the instant the regulator is actuated by a variation in speed the water wheel will receive its greater or lesser supply of water and thus be enabled to maintain a constant speed.

If the water wheel gate works in the manner described, any one of a number of regulators now on the market will keep the speed variations, and consequent potential variations, within very narrow bounds, and the question of keeping a constant load on the water wheel, with the attendant objectionable operating devices of this system will not need to be considered.

An arc plant with its automatic current controllers, driven by a water wheel equipped as indicated above, will run for an indefinite period with little or no attention, but incandescent lighting and power machinery require somewhat more supervision.

Although one of the chief inducements which manufacturers hold out to intending operators of electrical plants is, that the multiphase system permits both light and power to be obtained from the same generator, yet I hold it is a mistake to attempt to supply power from a lighting circuit except in very small units. Incandescent light and power should, I feel certain, never be run from the same water wheel. One of the greatest recommendations for the glow-lamp as an illuminant is its steadiness, but this quality is almost unknown when motors which are frequently started and stopped are run on the same circuit.

The separately driven exciter is a great boon to water power users whose loads are subject to great variations. Its many advantages are so apparent that it seems unnecessary for me to do more than merely mention it in passing. Another arrangement, the utility of which speaks for itself, is the automatic field controller, which strengthens or weakens the generator field circuit according as the potential on the line falls or rises.

An incandescent lighting plant requires a certain amount of hand regulation, although the apparatus just referred to is useful, within certain limits. All hand regulation necessary on a lighting circuit should be done, figuratively speaking, as far away from the lamp as possible; in other words, it is the field circuit of the exciter that should be varied when it is necessary to change the potential on the line. The exciter field rheostat should be of large range and divided into a great many sections, so that the movement of the rheostat-arm from one point to another would cause such a slight change in field current as to make a scarcely perceptible difference in the brilliancy of the lamps.

Where large regulators are used and many circuits are run the use of individual circuit regulators becomes imperative. But, I find I am digressing from the theme, and am already well into the consideration of the switchboard, a point I did not intend to raise at all.

Before placing my convictions as to the operation of water driven power and lighting plants before you for vivisection, I desire to mention two little pieces of mechanism which will not only tend to improve a service but may hinder the occurrence of a "run away" with its disastrous results. The first device to which I desire to direct your attention is an automatic speed indicator and alarm, which, as its name implies, always points out the speed at which the machinery is running, and also loudly rings a bell or gong at every change of speed, no matter how slight it may be. The other machine referred to closes the water wheel gate the instant the speed rises above a predetermined point. It consists chiefly in a pair of friction pulleys mounted in a frame. One of the friction pulleys is continuously driven from the machinery to be controlled, and the other is connected to the gate-closing apparatus. These friction pulleys are normally placed apart and are brought into contact by a weight or spring, which is released by a lever attached to a pair of governor balls. The instant the speed rises a certain percentage above the normal, the governor balls move the lever, and the weight or

spring being released the frictions are pulled together and the gate is immediately closed down before any damage can be done.

It would hardly seem correct to leave the subject of the operation of water power plants without at least mentioning that bane of water power users—anchor ice. If wheels are favorably situated, that is if they are supplied from a large pond in which there is little or no current and if there is an overflow or by-wash into which most of the floating ice can be diverted, by extreme watchfulness a complete shut-down can be prevented. But, if the wheels have no still pond from which to draw their water supply it is prudent to resort to the auxiliary steam plant as soon as there is the least suspicion of the approach of anchor ice.

I have striven to deal in a general and concise manner with the operation of water driven lighting and power plants. So much could be said about each of the various parts of such plants from the wheel-pit to the cupola that I have, for the sake of brevity, refrained from particularizing except where it seemed absolutely necessary so to do. Should even a single user of water power derive a benefit from any of my remarks, I shall consider myself amply repaid for the labor expended in placing upon paper my very unassuming sentiments.

THE STEAM END OF AN ELECTRIC PLANT.

By A. M. WICKENS.

IN VIEW of the fact that we are holding this convention at the place where is situated the greatest water power in the world, where recent developments have done so much to advance the usefulness of large water powers, and the transmission of electric currents to long distances, as well as the establishing of large electrically-driven factories situated near the developed power, it seems almost an anomaly to speak of steam power. The position of a great number of the Canadian water powers is so far removed from commercial and manufacturing centres, that even with the present and prospective advance in the transmission of electricity, a very great number of our electrical plants must still rely on steam and the steam engine as their motive power. This being the case, it behooves us to enquire more particularly into the working, the efficiency and cost of operating an electrical plant by steam.

Our friends, the manufacturers of dynamos, tell us with some considerable pride of the rapid advancement in this class of machinery, and claim to be able to make a generator that has an efficiency of 95%. This statement, I believe, is reasonably borne out, and leaves us in the position that if we expect any further economy we must look to the prime movers or engines and boilers for it, unless our electrical engineers can approach the glow-worm in efficiency, which makes its light with about one three-hundredth part of the force used in our ordinary incandescent lighting plants—or should the electrical engineer reach, in the near future, vacuum illumination, without incandescence, we should have a light at 1/6 or less of the present cost for power. But during the time these inventions are being perfected we must do the best we can with our steam engine and boiler as prime movers in hundreds of our electrical plants. Space and time will not permit us to go into a history of the evolution of the steam engine, neither can we go into the actual merits of the different makes of steam engines. There are many engines running to-day that are running with an efficiency of from 70 to 80%; notwithstanding this the waste between the coal pile and the dynamo pulley reaches 1/6 of the total heat in the coal. Our steam engine is only a heat engine, and is subject to many losses—in fact, in some of the old engines, with large cylinders and slow piston-speeds, the water consumption was as high as 60 lbs. per hour per H. P., while to-day, with our higher boiler pressures and faster piston-speeds, with early cut-offs, we reduce that to 12 1/2 lbs. water per H. P. per hour.

The heavy cylinder losses in the old, slow-running engines caused engineers, as far back as 1825 to 1830, to look for higher pressures, and at the latter date Mr. Perkins in London succeeded in using pressures from 500 to 1500 lbs. per sq. in. This very high pressure at that time was only expanded eight-fold, and even under such adverse circumstances gave a H. P. for about 12 lbs. of water per H. P. per hour. Some of the earlier engines gave 5,000,000 foot lbs. per hundred lbs. of coal. Watt built engines that gave a duty of 100,000,000 to 120,000,000 foot lbs., while some of the modern compounds give from 130,000,000 to 150,000,000 foot lbs., thus showing a reduction in fuel from 12 lbs. per indicated H. P. to 1 1/2 lbs. or even 1 1/4 lbs. for each H. P. The ratios of expansion have also materially increased—from twofold to twenty-fold—and thermo-dynamic considerations say we should still increase the number of expansions. The engineer in striving after too many expansions may find himself over-weighted with engine friction and internal wastes by using too many cylinders to accomplish his object. A recent engine built at Sibley College, with four cylinders, operated under 500 lbs. pressure, at high speed, is claimed to have developed a H. P. with less than 10 lbs. water per H. P. per hour. It is, of course, fitted with re-heaters between each of the cylinders, and is carefully covered to prevent loss of heat by radiation.

Our greatest loss is the loss of the latent heat in the steam discharged into the atmosphere or condenser, and as far as known is unavoidable. The combustible in one pound of coal will contain about 14,500 heat units. A well-designed and properly set boiler will deliver to the engine for work in the cylinder 70%, or 10,000 heat units for each pound of coal burned. If this was all utilized we would have a H. P. of 0.26 of a pound of coal per hour. But by the highest engine efficiency yet attained we use 1 1/2 lbs. coal per H. P. per hour, or only about 17% of the energy delivered by the boiler is converted into mechanical work. It is safe to say the average engine of the best makers, running in the electrical plants in Canada, requires at least 3 1/2 lbs. coal per H. P.

hour, thus discharging into the atmosphere over 90% of the energy supplied by the boiler. There are cases where the coal consumption is even higher than 9 lbs. per H.P. per hour, but these are either the result of avarice or ignorance—avarice in men who are imbued with the idea that a cheap boiler and engine is an economical machine and that it can be operated by cheap labour; and ignorance on the part of men who claim to be engineers, but who are only dabblers in mechanics, slick salesmen or merely stoppers and starters in the engine room.

The evaporation of water per lb. of coal varies to an alarming extent, and goes from 5 or 6 lbs. to 10 or 11 lbs. water per lb. of coal. Among the various causes for this, is the different calorific values of the coal itself, the difference in the construction of the boilers, the numerous different kinds of setting, and most of all the kind of a fireman you have shovelling the coal into the furnace. The average evaporation with ordinary return tubular boilers does not exceed 6 lbs. water per lb. of coal burned. If the boiler is well set and well fired an evaporation of 8 lbs. water can be obtained. This supplied to an engine giving a H.P. for $3\frac{1}{2}$ lbs. coal per H.P. hour, would represent a water consumption, as per indicated card, of 28 lbs. water per H.P., and is called good practice. If we increase the evaporative capacity of the boiler and evaporate 9 or 10 lbs. water, we are making a great saving. Again, if we increase the efficiency of the engine until we only consume 15 lbs. of water, we have also made a saving that will look well at the end of the year's accounts. Even with our best arrangements our heat losses are great, and engineers are looking for further improvements.

Among the most recent is the superheating of the steam, a plan that was very fully tried and discarded about 30 years ago. The practical difficulties supposed to be prohibitory to the use of super-heated steam, seem to have been overcome, later experience having shown that by purifying feed water the parts of the super-heater do not show signs of scaling, burning or other injury, and with the improved lubricating oils no further difficulty need arise in the pistons or wearing parts of the cylinders. In a recent paper on super-heated steam engine trials, read before the British Institution of Civil Engineers, by Professor Wm. Ripper, M. Inst. C. E., the author says: "The heat expended in super-heating reduced the amount of heat employed in evaporation of water; but the heat so diverted for the purpose of super-heating, was shown to be productive of a considerable gain in thermal efficiency. Thus an expenditure of 5, 10 and 15% of the furnace heat to super-heat gave a net gain of 12, 28 and 70% respectively of the work done for the heat supplied. When the load on the engine was fairly constant very little regulation of the super-heat was necessary, and the temperature of the superheated steam in the coils remained remarkably steady. When the steam was superheated it was in a more stable condition than without super-heat, and if the steam contained sufficient excess heat, the steam in the cylinder could be rendered dry at cut-off and release, thus removing all water in the cylinder, which is the great loss in the cylinder, also reducing the amount of heat exchange between the steam and the cylinder walls. One example shown was with steam at 120 lbs. pressure per sq. in. superheated to 674 degrees Fah., which in use reduced the steam consumption from 38.5 lbs. to 17.05 lbs. per indicated H.P. per hour. The rate of decrease of steam consumption being approximately uniform within certain limits, the best results were obtained when the steam was supplied at about 650 deg. Fah. at the engine. It is also important to cover cylinders and pipes with good non-conducting material to maintain the high temperature as long as possible."

This shows that engineers are looking for higher temperatures without increase of pressure as one means of improvement and economy. Thermo-dynamics tell us, and the whole trend of modern steam engineering convinces us, that higher temperatures and pressures, increased ratios of expansion and higher piston speeds are all conducive to a greater economy in the use of steam.

For the larger electrical plants, that is those of one or two thousand horse power—we need hardly say very much, because they generally have some one at their head with sufficient engineering ability to make a fairly economical running plant—that is, if the board of directors will allow them to spend enough money for this purpose. These larger plants are usually in our cities, where ground is valuable, and oftentimes water for condensing purposes is not obtainable. To these plants a way is open for cheapening the cost of operation by adopting a water-cooling tower and circulating pump, the cost and operation of which was so carefully gone into last year by Mr. E. J. Philip in his paper on that subject.

The smaller stations—and their number is nine-tenths of all our electric plants—are in a somewhat different position; in fact, many of them are paying a very small return for the money invested. The problem for many of them is: What can I do to make ends meet? In many cases this is not surprising to the engineer. The plant perhaps consists of one, two, or more engines, bought more with a view to saving first cost than anything else. The boilers are also the same—perhaps overrated as to capacity; the setting of each is poor, and their relative positions are bad; chimney drafts not good; boiler tops and domes uncovered; steam pipes bare, feed water pipes bare, and a few small leaks here and there of steam and water—the whole topped off with an engineer (?) at the munificent salary of \$1.00 to \$1.25 per day of 12 or 13 hours. No part of this plant is clean, and in engineering cleanliness is next to godliness; the man has neither time nor inclination for such work. The boilers are dirty, too, for want of cleaning out and the proper appliances to do it with.

Let us see what some of these things mean in coal. In the first place, a badly set boiler with a few small cracks here and there will not evaporate more than 4 or 5 lbs. of water with 1 lb. of coal,

while a well set and well fired boiler of the same kind will most likely reach 7 or 9 lbs. water with 1 lb. coal. This is a loss of from 25 to 35%. The main steam pipe is uncovered. What does that mean in coal? We will suppose the steam pipe is four inches diameter and 40 feet from boiler to stop valve at engine. Each square foot of this pipe will condense $\frac{1}{2}$ lb. of steam per hour, and each foot in length represents one square foot of surface; we have 20 lbs. steam per hour lost. An all-night run will average 11 hours per night, and the steam lost per year is 80,300 lbs., and, with your poor evaporation, 8 to 10 tons of coal per year. If your steam pipe is large and longer than the above, it will cost correspondingly more. If your pump pipes and heater are bare, the loss from this will be from 30 to 40 degrees to your feed water, which means respectively 3 and 4% of fuel. If you are burning $2\frac{1}{2}$ tons coal per day, this means a ton of coal every 10 days. If the domes and boiler top are uncovered, and the boiler is $6' \times 14'$, you will have 90 sq. ft. exposed, and the loss in coal will be double the loss in your steam pipe—say 19 tons of coal per year. If the boiler is sealed inside, the conducting power of scale is very low—being, according to D. Rogers, as 1 is to 37½. Nystrom tells us that with clean plates $\frac{1}{4}$ -inch thick steam at 75 lbs. pressure can be produced by heating the plates to about 325 degrees, while if $\frac{1}{2}$ -inch scale intervenes, it will be necessary to heat the plates up to 700 degrees—very nearly a low red heat—and a heat at which the iron becomes granular and brittle; a scale of $\frac{1}{16}$ of an inch thick requires 15% of fuel extra.

The troublesome substances in our feed waters are earth, clay, bicarbonates of lime, sulphate of lime, chloride sulphate of magnesium, carbonate of soda, magnesia, dissolved carbonic acid and oxygen, iron and acid. These substances can all be treated in such a way that they will be removable. Some require caustic soda and lime, some need barium, others require chloride; all organic matter needs alum or ferric, and should be filtered.

If boilers are kept clean and well fired, the saving in coal amply pays for the cost, leaving a good margin of profit for the proprietor. A small leak through the exhaust valve of the engine soon makes itself apparent in the coal pile. Badly set engine valves are often prolific sources of loss; I have corrected engine valves and made a saving in coal of 12%.

To the owners of the smaller plants I would say, make the best of what you have got; stop all the small leaks and losses; get more of the heat in the coal into the engine, and keep the engine right. If you are burning 1,000 tons of coal per year you can save at least 25%, or 250 tons, by keeping everything right; 250 tons of coal means in many places \$1,000. This in many places can be saved by expending 40 or 50% of it the first year—after that it should all be saved. Get a thoroughly well posted engineer to look over your plant and advise you as to where savings can be made; don't go to a civil engineer or to an electrical engineer, consult a mechanical engineer. If you had a bad fever you would not go to a dentist for treatment. Go to the right kind of an engineer, pay him for his advice and follow it, and make an ordinary electric plant a reasonably good paying investment.

DAY LOADS FOR CENTRAL STATIONS, AND HOW TO INCREASE THEM.

By J. A. KAMMERER.

At no period since the inception of the electric lighting industry have central station managers and operators taken such a deep interest in all the details of their plants.

As an evidence of this, there is no more encouraging sign, than the constant desire by operators for the most complete information concerning, and a fuller understanding of, the apparatus they are using.

This interest is not exhausted by enquiring and becoming familiar with the different points in the apparatus they are using, but is extended to the underlying principles of the relation between the cost of producing electric current, and the compensation received therefrom.

Study of this relation is being logically and systematically undertaken, and is more and more made a basis upon which the earning capacity of the plant is calculated.

The result of this movement is making itself felt in no small measure by those pioneers in electric lighting work, who are now profiting by their experience and reaping the first benefits of the departure from old lines of conducting electric lighting business.

The ruinous effects of many of these old business methods are now largely recognized by central station managers, and their energies are being directed to retrieve what has been lost in the past in this respect. They are re-arranging their plants, or are completely reconstructing the same, with more efficient apparatus. One of the first questions asked by a pioneer central station manager, when he desires to purchase a new piece of apparatus is, "what is its efficiency?" not "what is the price?" He knows that the true value of everything in connection with central station work, in fact, with the entire plant is "efficiency" or cost of operation, and "quality" or cost of repairs. His whole work must be to make the plant more efficient, and less expensive to operate and repair, and hence more remunerative in order to pay a dividend on the invested capital. This is being brought about in part by the reconstruction and rearrangement of the central stations, and is the first and essential step, but the effort does not stop at this work.

Other means of procuring remunerative return for energy expended and capital invested must be and is being sought. Increase of rates cannot be looked for, therefore additional income at present, or at even less rates, must be obtained. Such additional revenue must be obtained from increased and prolonged use of current, to obtain which, means of having current used for other

purposes than illumination must be found, and consequently use in the day-time or a "day load," as it is called, must be secured.

It is claimed, and it must be admitted with some truth, that because the particular business of electric lighting companies is night-work, they should not look for a day load, any more than a woollen mill or any other kindred industry should look for a night load. This at first blush looks reasonable, but were the margins on the woollen mills or other commodities as small as they are in most of our cities and towns on electric lighting, the woollen mill would either have to close up, or make its plant investment work day and night to make ends meet.

Then here is where the dividing line can be clearly drawn. The one industry or industries can exist because the margin of profit on their product is sufficiently large to pay a reasonable return on the capital invested by operating their plant at its maximum output only 10 or 12 hours out of 24. On the other hand, a central station operating a lighting load only is handicapped, because it cannot procure a maximum load for even 2 hours out of the 24. Its maximum investment is therefore only exerting its full earning power for less than 2 hours instead of 10 or 12 hours daily.

The aim then must be to place electric lighting central station business on the same footing as any other industry, by making the plant investment work a greater number of earning hours in each twenty-four. To accomplish this there must be, in addition to its regular work, a day load for the lighting plant.

The operation of a day service for electric lighting prevails only in a few of our larger cities. This is usually had, however, by a separate service, necessitating the investment in, and operation of two systems, one for lighting and one for power—which is too expensive for small central stations, and still leaves the question of the maximum investment and maximum earning hours unsolved, as the lighting system will still have only a very small day load, as against whatever a separate power service might earn. The difficulty must therefore be met by making as small an investment as possible in what will take care of a combined light and power load.

The multi-phase alternating current system, by which motor power can be provided as well as arc and incandescent lights, meets the situation in this respect.

With existing single phase alternating current lighting plants, the change can be made without any considerable expense other than in the generator, as everything is already in place for the lighting, and the only expense for motor service is a small increase from time to time on capital account, as demand is made for power.

No capital invested need lie idle waiting for business to turn up, as there can always be a return in sight on any investment before the extension is made. This holds good to a greater degree where a new plant is being installed, as the outlay is proportionately less, owing to the fact that arc and incandescent lights as well as power may be served from the same circuits and generator. In this manner the central station is in a position to cater for a day load.

The cost of supplying a day load, in comparison with a night load only, is very much less, as the fuel necessary to start up the cooled boiler, and that for maintaining banked fires during the day, would be saved. The depreciation on apparatus would be slightly greater, but the interest on everything and the depreciation on lines, poles, etc., is the same as if it were only an all-night run, thus making the additional expenses for the day run much less than the night run alone.

The central station operator is then in a position to give lighting service all day long, and add to his lighting business those consumers who have been heretofore objecting to using incandescent light, because of the necessity of maintaining coal oil or gas lamp lighting in dark places in stores, cellars, etc., during the day.

Where there is an electric light day service such consumers cannot offer the excuse now made that risk from fire is as great with a few gas jets or coal oil lamps, as though they were to light throughout with an open flame light, and that the matter of the small additional cost of incandescent light is not their reason for not using it. As the central station can remuneratively furnish incandescent light throughout the 24 hours this objection is removed, and a large amount of profitable business, which before could not be handled, can now be secured.

In dry goods stores where delicate fabrics are being handled, and where an open flame light creates risk from fire, the objection that different delicate colors cannot be distinguished by artificial light is removed, as an arc lamp can be placed in these stores operating from the alternating current system, which gives a near approach to solar light, and makes it an object for the storekeeper to install this light, as by it delicate colors are easily distinguishable.

By an all-day service there would be removed another hindrance to extended use of incandescent light. The objection is frequently and fairly offered that if incandescent light is only available during the hours of atmospheric darkness, or from dusk to daylight, it is necessary to have in reserve and ready for use at all times another source of artificial light in case of very dark days; and the conclusion is reached and acted upon, that as it is necessary to have a number of these lamps on hand, which must be kept ready for use at any moment, electric light being available during only a portion of the 24 hours, there is no reason why it should be used at all, although if available at all times it would be used because much preferred for so very many reasons.

While the additional revenue secured from these lights may not be sufficient to pay the extra expense of running a day service, yet it must be borne in mind that it is not alone the day load the central station is getting, but also an additional night load consequent on customers being provided with light for the full 24 hours.

This must be taken into consideration as making the night-load more remunerative at a very small added cost.

These briefly are the points from a lighting standpoint that will commend themselves, and, no doubt, are familiar to most of the central station operators.

Aside from all this is the strictly speaking day load, which consists of the motor load, and which it is possible to secure with the multi-phase alternating current system. As a rule there is the butcher with his meat chopping machine, the baker with his dough-mixer, the newspaper with its printing press, the foundry with its line of shafting to drive, and the planing mill with its machinery to be kept going throughout the day, in every town, while other and larger industries will be attracted to a town in which a day power service may be obtained. These different industries all using power during the day-time tend to create a steady load line, which is especially desirable, as it increases the number of hours in which the investment is exercising its earning power, and helping to increase and secure the maximum load line throughout the 24 hours.

ACCUMULATORS—THEIR APPLICATION TO CENTRAL STATION LIGHTING AND POWER.

By W. A. JONSON.

To those who have given attention to the use of accumulators and have posted themselves sufficiently to have even a fair idea of their adaptability, it seems incomprehensible why the central station owners in Canada have so long delayed availing themselves of their advantages.

Considerable misconception seems to exist in reference to the cost of installing a storage battery. Like all good things having value accumulators are not given away, and the station manager who is waiting for them to get cheaper is letting one-third of the earning power of his station go to waste.

Local conditions, of course, determine the capacity and consequent cost of battery, but in general terms the cost may be stated to be less in most cases than the cost of generating plant.

When it is desirable to increase the capacity of a station, it means besides new dynamos, increase in engines, boilers and all steam appliances, and usually alterations in the building, and while the output of the station is increased the general efficiency remains about the same, and often times the running expenses of a moderate sized station is greater per h. p. output, owing to the increase in the working staff.

On the contrary, to increase the capacity of a station with accumulators requires, as a rule, no alteration or increase of existing steam plant, no new dynamos, and usually, owing to the small space required, plenty of room can be found in the station for the storage battery.

When such a change can be made, what are the results? The available output of plant has been largely increased; no increase in working staff is required; the operating expenses are no higher than before; the all round efficiency of the station is fully 30% more, and consequently the profits are enlarged by nearly the same proportion; the plant can thereafter give uninterrupted service 24 hours per day every day in the year, as the battery is always available when a temporary shut down of the machinery is necessary.

The regulation of the voltage to the lamps is kept constant—more perfect than can be possible when no batteries are used, as the battery is a regulator to the whole system. When motors are operated this is a big advantage.

No gas company would for a minute consider the operation of their plant without a storage tank; just think of the large increase in retorts and men to keep up a constant gas supply without a storage tank. Most waterworks systems require a reservoir, and yet electrical people, who are supposed to keep abreast of the times, try to get along without a storage tank to fall back upon for hours of maximum, minimum or average demand.

The central station manager will answer that he does not know the cost of maintenance, and is waiting for the other fellow to prove the case. The other fellow has proved it. In Germantown, Pa., there has been a battery having a capacity of 120 h. p. hours in use for over three years, or long enough to give a fair idea of the cost of renewals.

The management of the large stations in Boston, Brooklyn and New York, however, did not await the results in Germantown, but put in large batteries from one to two years ago, and these have since been doubled, and in one case recently enlarged for the fourth time. But interested parties can go back of the returns from the United States for further endorsement of the practicability of accumulators.

In Germany, France and England they have been largely used for years past.

Out of a recently published list of 30 cities in Germany, only ten are without accumulator plants. The population of these cities range from 4,000 to 85,000. This shows that there is hardly a town or city electric plant but can use accumulators to advantage.

I mention the following among American companies who have put in large batteries, and the capacity installed as rated in h. p. hours:

Company.	H. P. Hour Capacity.
Hartford Electric Co.	3,000
Boston Edison Co., four batteries, a total of.	7,400
New York Edison Co.	3,200
Brooklyn Edison Co.	1,600
Germantown Electric Light Co.	300
Electric Railway, Light & Power Co., Anaconda, Montana.	500
Woonsocket Electric Machine & Power Co.	400
Eastern, Pa., Edison Co.	200

These last three plants are used both for railway and lighting work

As good an illustration as I can give of the application of the storage battery to railroad work is to refer to the equipment of the Union Traction Company of Philadelphia, who use a battery of 400 h. p. hours for keeping up the pressure at the end of a feeder at a point about 11 miles from the power house, the new extension continuing several miles beyond. In this case the battery took the place of a new power house, or what amounted to the same thing, an increase at the old power house with enlarged feed wires. It was found that the cost of copper feed wire to operate from the main power house alone would have cost four times the total cost of a battery. Previous to the installation of the battery the pressure at the end of feeder formerly in use frequently varied as much as 50°; the battery, however, gave practically a steady pressure at all times. Railroad men need not be told how much better for their motors and controllers the maintenance of a standard working pressure is than one which falls so low as to require an increase in the current passed through the apparatus of from 50 to 100°.

In the above case the load varied from one hundred to seven hundred amperes, and with the feeder of a capacity at a constant load for four hundred amperes the demand upon the power house was at all times equivalent and independent of the changeable load on the batteries.

Under such an arrangement the power house generator always operates at full load and highest efficiency, and the battery acts as a cushion to the engine when the line circuit breaker opens from any cause.

Some of the electric street railroads in Canada serve a district up to 7 miles from the power house as originally laid out, and in all cases extension will be called for to reach suburban points at a greater distance and to connect through as radial lines to still more distant points. In such work the accumulator plant at the end of a feeder is destined to be an important factor in the near future, and the little trouble in operating a sub-station for this work is very satisfying to the purchaser, as the battery is automatic in charge and discharge, the only attention required being the usual occasional testing of the E.M.F. of the individual elements and the keeping of the electrolyte to the standard specified gravity (1.200).

The sub-station apparatus and connections are very simple, being only the main switch, ammeter, circuit breaker, voltmeter and recording voltmeter. The flow of the current to the line being always proportionate to the demand, one central station can therefore take care of any number of accumulator sub-stations, and the area which can profitably be covered with continuous current either for railroads, lighting or power greatly increased.

The claim has been made and experience seems to prove it true that it costs practically nothing for the energy stored in accumulators in the average lighting, power or railroad station, whether operating on a twelve or twenty-four hour basis, as, if judgment is used in proportioning the size of battery to generating plant, the battery is always being charged during light load and discharged during hours of heavy load, and owing to the all-round higher efficiency, the amount of coal burned will be about the same and the current given off from the batteries will represent net profit.

While the above is a simple way of putting it the following gives in figures the actual conditions obtained in a plant now working:—Total time of operating steam plant, 9 hours; total steam plant required, dynamos working at an efficiency of 90%, 93 h.p.; total steam plant required, if battery is not used, 165 h.p.; saving in steam plant, 72 h.p.; total dynamo capacity required when using battery, 62,500 watts; total dynamo capacity required, without battery, 111,250 watts; saving in dynamos, 48,750 watts. In this case the battery was in service a total of 18½ hours and during 15 hours the battery served the entire plant.

In making provision for a storage battery the room provided should, if possible, have a cement or tile floor, and should be well ventilated. Owing to the compact form of the elements, sufficient room can usually be given when arranged in tiers, one above the other. The space required for a battery capable of giving 400 h. p. for one hour per element is 14½ by 20½ inches, and as 248 cells would be used on a 500-volt system, only about 630 square feet would be necessary, this being for a battery of fairly large capacity; in fact, being equivalent to that installed by the Union Traction Company in the before-mentioned instance. A suitable battery having been purchased, it requires as careful attention as is given to any other class of electrical or steam apparatus, and no more, and yet this attention is very simple; but it must be given as required, otherwise the results would be similar to that caused by neglect of a dynamo or steam boiler. There has been no instance where a properly constructed battery that has received fair treatment has failed to give good results. Attention should be paid to the proper strength and nature of the acid, the specific gravity of the acid being tested at regular periods. The individual testing of each cell by a low reading volt-meter is the key note to successful battery operation. While in general the reading of the volt-meter connected with all the elements will give sufficient information, yet the occasional individual testing of each element prevents any single cell from being allowed to work at a disadvantage. The chloride type of negative plate has been found to be most satisfactory, and is largely in use for central stations. The positive plates generally used with chloride negatives are of the Tudor type, and are capable of giving a very high discharge, their capacity being at nominal rating from three to five ampere hours per pound of element. Such a battery is not liable to buckle or sulphate. There are numerous small water powers that have not been considered as applicable to electric lighting owing to the small h.p. available, but if 20 h.p. can be obtained for 24 hours per day, and if a battery is used in connection therewith, 120 h.p. is available for four hours, or sufficient for the requirements of a fair-sized town. I know of one instance, in a

town of from eight to ten thousand inhabitants, where a water power of 50 h.p. is available, and not used at present. This power, if stored in batteries, would give 200 h.p. for six hours, or sufficient to supply all the street commercial and residential lighting which is now operated by steam.

SPARKS.

Mr. L. O'Connor has been appointed electrician of the town of Thorold, Ont.

An electric light plant will shortly be put in running order at Woodville, Ont.

The town of Tilbury, Ont., will vote on a by-law to raise funds for improving the electric light plant.

The Goldie & McCulloch Co., of Galt, Ont., are building a 150 horse power engine for a flour mill in South Africa.

Mr. Henry Surtees, son of the city engineer of Ottawa, has been engaged as chief electrician of the Quebec District Electric Railway.

Mr. Geldart, engineer for Messrs. Dymont & Baker, London, Ont., in renewing subscription to the ELECTRICAL NEWS, states that he finds the paper very interesting and instructive.

By the collision of a freight motor and a passenger trolley car on the Galt, Preston and Hespeler electric railway, several passengers and the conductor and motorman were slightly injured.

Wm. Snider & Co., who have recently entered the electric lighting field at Waterloo, Ont., are putting in a 75 horse power Corliss engine to operate their dynamos, which were purchased from the W. A. Johnston Co., of Toronto.

Only one tender having been received for lighting the town of Owen Sound by electricity, the Fire and Light Committee of the council have recommended the purchase of a civic lighting plant, the cost of which is estimated at \$27,000.

We are informed by Col. Stacey, of St. Thomas, Ont., that arrangements are likely to be completed at an early date for the conversion of the street railway in that town to an electric system, with radial lines extending to the adjacent villages.

A proposition was recently made by the Chatham City and Suburban Electric Railway Company to construct a radial railway, with the city of Chatham as the centre, and to supply that town with 100 electric lights at \$7,500 per year. The arrangement was to take the form of a bond guarantee, given by the city of Chatham, under which the company could float its securities. Voting on the by-law took place on May 29th, but the result was the defeat of the proposition. Col. Geo. C. Rankin was one of the promoters of the enterprise.

The longest electrical transmission plant in the Dominion of Canada was put in operation May 13, 1897, near Three Rivers, Que. This plant was installed by the Royal Electric Company of Montreal for the North Shore Power Company, and transmits 700 h.p. from Grand Chute, on the Batiscan river, a distance of 17 miles, to the city of Three Rivers, Que., where the power is used for arc and incandescent lighting, as well as for power. S. K. C. two-phase apparatus is used throughout. A full description of this, the first long distance plant of such high voltage in Canada, will be published very shortly.

By a regulation of the Inland Revenue Department made on May 7th, 1897, a change has been made in the inspection of electric light meters, by which the charge is now made according to the number of lights instead of amperes. It was found that the regulation of the fees by amperes was so perplexing that it was advisable to change the basis, and the rates are now as follows: Meters of 10 lights and under, 75 cents; over 10, and under 20, \$1.25; over 20, and under 30, \$1.75; over 30, and under 45, \$2.25; over 45, and under 60, \$2.75; over 60, and under 80, \$3; over 80, and under 100, \$3.50; and for every 20 additional lights, or fraction thereof, 50 cents. A light means a 16 candle-power incandescent lamp, consuming electrical energy at the rate of 15 watts.

TRADE NOTES.

The London Electric Motor Company, of London, Ont., has recently installed a ten h.p. motor for Norway Cabinet Co., and a two h.p. motor for Mr. Wilcocks, corner Dufferin and Dundas streets, Toronto.

The W. A. Johnston Electric Company, Toronto, are at work on the dynamos for two new steamboats for the Lake of the Woods and Seine River mining district. They also report recent sales of their motors to Montreal, Kingston, Ottawa, Berlin, Preston and Toronto.

On the 1st of April, conducted by Mr. O. E. Granberg, Boiler Inspector, and Mr. Alfred Trevelthick, M.E., Montreal, a test was made of the Jones Underfeed Mechanical Stoker, recently installed at the Windsor Hotel in that city. The result is said to have shown an economy over hand firing under former conditions of 46.7 per cent. The T. Eaton Co., Ltd., of Toronto, are replacing three Hlawley down draft furnaces with the improved stokers.

The W. A. Johnston Electric Company, Toronto, report the sale of direct current generators and engine and boiler for the new mining town of Mine Centre, Ont., this plant to be used for commercial lighting and power. They have made a recent shipment to the Lachine Rapids Hydraulic & Land Company of one car load of Wagner transformers, weighing 44,000 lbs., and of a capacity of 18,000 lights, and announce a further sale to the same company of 450 kilowatt transformer capacity and voltage 4,000 x 1,000 volts.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically useless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been followed for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBIC AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE II.]

DECIMAL FRACTIONS.

A DECIMAL fraction is one whose fractional units are tenths, hundredths, thousandths, etc.

[NOTE.—The denominator of a decimal fraction is not expressed as in common fractions; instead of expressing the fractions $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$, they would be decimally expressed as .1, .01, .001.]

The decimal point is the character (.). It signifies the decimal when placed on the left of the fractional units expressed, and separates the integer from the decimal, as it is on the right of the former and on the left of the latter.

Decimal places consist of the number of figures on the right of the decimal point.

The value of each place is shown in table of decimal notation:

DECIMAL NOTATION.

Hundred Millions Ten Millions Millions	Hundred thousand Ten thousands Thousands	Hundredths Tens Units	Decimal point	Tenths Hundredths Thousandths	Ten thousandths Hundred thousandths Millionths
4 0 1	2 3 5	4 0 9	.	4 7 8	3 4 2
9th 8th 7th	6th 5th 4th	3rd 2nd 1st		1st 2nd 3rd	4th 5th 6th
Integers				Decimals	

[NOTE.—It will be observed that the integers are numerated from right to left, and the decimals from left to right. Thus the figures on the left of the decimal point express the number of units or integers, and those on the right of the decimal point the number of tenths or decimal parts of a unit.]

A pure decimal is one in which no integer or common fraction is expressed.

Thus .5, .125, .0625.

A mixed decimal is one which contains an integer and a decimal.

Thus 4.5, 3.125, 84.0625.

The chief principles of decimal notation are:

1st. Annexing ciphers to a decimal does not effect its value. Thus, if a cipher be annexed to the decimal .1, it would then be .10, and changed from tenths to hundredths, but the fractional units are increased tenfold; hence no change in value takes place.

2nd. Prefixing a cipher to a decimal fraction and moving decimal point to the left decreases the value of the decimal tenfold, or is equivalent to dividing by 10.

3rd. Moving the decimal point to the right one point increases the value of the decimal tenfold, moving two points one hundred-fold, etc.

4th. Moving the decimal point to the left one point decreases the value of the decimal tenfold, moving two points hundred-fold, and so on.

5th. The numerator of any decimal is the number of fractional units it contains, and its denominator is 1 followed by as many ciphers as there are places after the decimal point.

[NOTE.—Thus, in the decimal .125 the numerator is 125, and since there are three places after the decimal point, the denominator is 1 followed by three cyphers, and fraction is read $\frac{125}{1000}$.]

It is important to the reader that the principle of decimal notation be thoroughly understood, since our scientists almost without exception adopt the metric system and express their formula and observations by decimal notation, and since micrometer gauges, calipers and rules are now in universal use, it is just as important that the principles of conversion of common fractions to decimal fractions and vice versa be equally well understood.

ADDITION OF DECIMALS.

Addition of decimals is the process of finding the sum of two or more decimals, and becomes an easy process once principles of decimal fractions are well understood.

Rule: To find the sum of two or more decimals, so place the decimals that the figures of same order shall fall in same column. Then add as in simple addition, placing the decimal point in the result between the integer and decimal.

Find the sum of 1.0625, .45, 87.5, .0007.

Proceed thus,

$$\begin{array}{r}
 1.0625 \\
 .45 \\
 87.5 \\
 .0007 \\
 \hline
 89.0132 = \text{Total.}
 \end{array}$$

SUBTRACTION OF DECIMALS.

Subtraction of decimals is the process of finding the difference between two decimals.

Rule: To find the difference between two decimals, place the less decimal or subtrahend under the greater decimal or minuend, so that the figures of any order or denomination in the subtrahend shall fall under those of the same order or denomination in the minuend. Subtract as in simple numbers, placing the decimal point in the result between the integer and decimal.

Example: Find the difference between .6504 and 75.0735.

Process as by rule:

$$\begin{array}{r}
 75.0735 \text{ (minuend)} \\
 .6504 \text{ (subtrahend)} \\
 \hline
 75.3231 \text{ (difference)}
 \end{array}$$

Example: Find the difference between .00785 and .625.

Process:

$$\begin{array}{r}
 .625 \\
 .00785 \\
 \hline
 .61715
 \end{array}$$

MULTIPLICATION OF DECIMALS.

Multiplication of decimals is the process of finding the product when either the multiplier or multiplicand, or both, are decimals.

Rule: To multiply an integer by a decimal, or vice versa. Set the factor containing the least number of figures as a multiplier and other factor as the multiplicand, proceed as in simple numbers. Point off as many decimal places in the product as are contained in BOTH FACTORS. If the product does not contain so many places, PREFIX ciphers to supply the deficiency.

Example: Multiply 147. by .75, proceed as per rule.

$$\begin{array}{r}
 147. \\
 \times .75 \\
 \hline
 735 \\
 1029 \\
 \hline
 110.25
 \end{array}$$

Since both factors contain but two places to the right of the decimal point, we require to point off this number in product.

Example (2): Multiply .75 by .025.

$$\begin{array}{r} .025 \\ \times .75 \\ \hline .3125 \\ .4375 \\ \hline .06875 \end{array}$$

Since both factors contain five decimal places we point off this number in product.

Example (3): Multiply .0625 by .075.

$$\begin{array}{r} .0625 \\ \times .075 \\ \hline .3125 \\ .4375 \\ \hline .0046875 \end{array}$$

Since both factors contain seven decimal places and product but five, we require to prefix two ciphers, and set decimal point to the left.

DIVISION OF DECIMALS.

Division of decimals is the process of finding the quotient when either the dividend or divisor or both are decimals.

Rule: To find the DECIMAL QUOTIENT when the divisor and dividend are both whole numbers, and the divisor is greater than the dividend, or when the divisor is not contained in the dividend an exact number of times.

Add as many ciphers to the dividend as there are decimal places required in the quotient, divide as in simple numbers, and point off from the RIGHT of the quotient as many decimal places as there have been ciphers added to the dividend, and USED, prefixing ciphers to the quotient if necessary.

Example: Divide 75 by 1506 to 4th decimal place.

Process as per rule:

$$\begin{array}{r} 1506 \overline{) 75.0000 (.0498} \\ \underline{6024} \\ 14700 \\ \underline{13554} \\ 12000 \\ \underline{12048} \\ 12 \end{array}$$

Since we wish to extend to fourth decimal place only, we annex to dividend four ciphers and proceed as in division of simple numbers, and get 498. Since, however, we annexed four cyphers to the dividend, and therefore require four decimal places in the quotient, we must prefix one cypher, and quotient will then read .0498, proving that the factor 1506 is contained in the factor 75 .0498 times, or that 75 is .0498 of 1506.

Example (2): Divide 743 by 125.

$$\begin{array}{r} 125 \overline{) 743.000 (.5944} \\ \underline{625} \\ 1180 \\ \underline{1125} \\ 550 \\ \underline{500} \\ 500 \\ \underline{500} \end{array}$$

Here we have an example where two whole numbers are to be divided an exact number of times. Since we find the divisor is contained in the dividend 5 and a fractional times, we add to the dividend a cypher and bring this down and annex to the right of the remainder, as in division of simple numbers, repeating this process until there is no remainder. We then proceed to ascertain the number of ciphers annexed to the dividend, and point off a corresponding number of places in the quotient, counting from the right. In example the 125 is contained in 743 exactly 5.944 times.

Example (3): Divide .9735 by 50.

$$\begin{array}{r} 50 \overline{) .9735 (.01947} \\ \underline{50} \\ 473 \\ \underline{450} \\ 235 \\ \underline{200} \\ 350 \\ \underline{350} \end{array}$$

Here we divide a decimal by a whole number, proceeding exactly as before, and since the decimal contains four places to the right of the decimal point, and we require to add a cipher so as to have no remainder, we necessarily require quotient to contain five decimal places, and have to prefix a cipher to the quotient to bring about this result.

To divide when both divisor and dividend are decimals, and the divisor contains more decimal places than the dividend—

Rule: Add ciphers to the dividend until it shall have as many places as the divisor; then proceed as in simple numbers.

Example: Divide .125 by .0515.

$$\begin{array}{r} .0515 \overline{) .1250000 (.24270} \\ \underline{1030} \\ 2200 \\ \underline{2060} \\ 1400 \\ \underline{1030} \\ 3700 \\ \underline{3605} \\ 950 \end{array}$$

This is an example of the application of principle 1. While we annex to the dividend a cipher we in no way change its value, and since we find .0515 to be contained in .125 two and a fractional times, we proceed by process already illustrated to extend to the fourth decimal place.

To divide when both divisor and dividend are decimals, and the dividend contains more decimal places than the divisor—

Rule: Divide as in simple numbers, and point off from the right of the quotient as many decimal places as the decimal places in the dividend are greater in number than those in the divisor.

Example: Divide .5000 by .125

$$\begin{array}{r} .125 \overline{) .5000 (4.0} \\ \underline{500} \\ 000 \end{array}$$

The application of both these rules is demonstrated in previous example. Since, however, we want to make the principle clear, we repeated in another form. The writer wishes especially to impress on the student the great importance of thoroughly mastering the principles of calculation contained in these exercises in common and decimal fractions. A thorough knowledge of the principles involved is of immense benefit in computing much of the formula we shall at a later date meet with; in fact, unless our knowledge of these principles is thorough we cannot hope to properly appreciate all the good things that the scientist has prepared for us.

There remains for illustration yet what concerns many of us, i.e., the principles involved during the conversion of common to decimal fractions and vice versa, which I will briefly illustrate before closing this number.

Since the denominator of a simple fraction is always larger than the numerator, to reduce or convert a common fraction to its equivalent decimal fraction we have to follow one of the rules already laid down for the division of decimals, dividing the numerator by the denominator and adding ciphers as required.

Example: Reduce $\frac{1}{16}$ to a decimal fraction.

$$\begin{array}{r} 16 \overline{) 1.0000 (.0625} \\ \underline{144} \\ 60 \\ \underline{48} \\ 120 \\ \underline{112} \\ 80 \\ \underline{80} \end{array}$$

Since we had to add to dividend four ciphers, we place the decimal four places to the left, counting from the right, hence $\frac{1}{16}$ reduced to decimals = .0625.

Example: Reduce .9375 to common fractions.

Since the numerator is .9375 and the denominator 1, with as many ciphers added as there is decimal places in the numerator, then fraction will be set thus $\frac{9375}{10000}$, which we reduce to simplest form:

$$\frac{9375}{10000} = \frac{1875}{2000} = \frac{375}{400} = \frac{75}{80} = \frac{15}{16}$$

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CANADIAN
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AIR COMPRESSOR AT LE ROI MINE.

WHAT is claimed to be the largest air compressor ever put in operation in Canada was recently installed at the Le Roi mine, Rossland, B. C., by the Rand Drill Company, of 100 Broadway, New York. It was built at their Canadian shops at Sherbrooke, Que., and is shown in the accompanying illustration.

The steam end is of the Corliss cross-compound condensing type, with high-pressure cylinder 22 inches in diameter by 48-inch stroke, taking steam through a pipe 6 inches in diameter. The low-pressure cylinder on the opposite side of the machine is 40 inches in diameter by 48-inch stroke. Both cylinders are fitted with the Corliss liberating valves, with vacuum dash pot, controlled by a sensitive governor operating on the releasing gear, the speed being automatically governed from six or eight revolutions to the maximum number of revolutions per minute, depending upon the air pressure. The main shaft is 14 inches in diameter by 13 feet

long, weighing about 5,500 pounds. The shaft is fitted with cranks pressed on under immense pressure. The connecting rod forgings and piston rod forgings are well and carefully finished. The air end of the machine is placed tandem with the steam cylinders, and is also of the compound type, the high-pressure air cylinder being 22 inches in diameter by 48-inch stroke. The valve motion supplying these cylinders is Rand's most economical type, being in the form of mechanical valves. The use of these valves insures the filling of the low-pressure cylinder with air at atmospheric pressure, which fact largely affects the efficiency of the machine, for were the cylinder either not completely filled, or were the air hot and expanded, in just such a ratio would, it is said, the efficiency be decreased. The inlet valves of the low-pressure or intake air cylinder are surrounded by a hood, which is connected to a flue for the introduction of the cold air from out of doors. Between the high and low-pressure cylinders is an intercooler of the latest

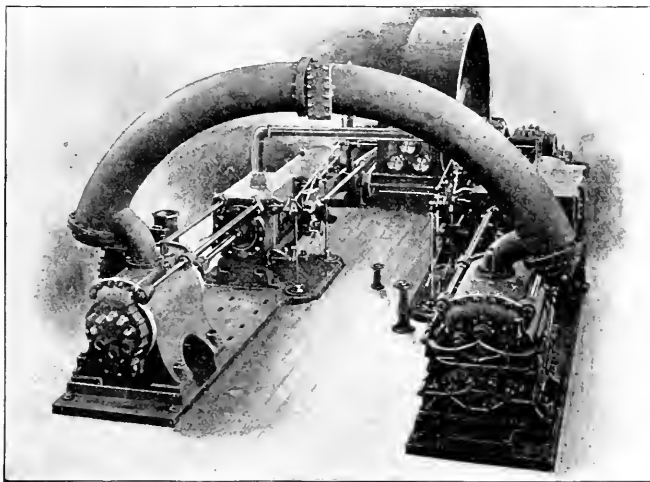
type, through which the air passes over a system of water circulating pipes and is cooled in the process. This giant compressor engine will be used for running all the pumps and hoists at the mine, in addition to operating 40 drills.

NOVEL METHOD OF UTILIZING WATER POWER.

PARTICULARS of a new method of utilizing the power of falling waters are given as follows in the Mining and Scientific Press :

The essential principal involved is the compression of

air by the force of the falling water, and the compressed air used to drive motors at the falls or be transmitted to a distance for the same purpose. From a tank or a stand-pipe, in which the water stands at the same level as above the dam, the water is permitted to pour down a pipe, around whose base are a number of holes, admitting air from tubes running up to the surface of



AIR COMPRESSOR AT LE ROI MINE, ROSSLAND, B. C.

the water. The air is sucked in and compressed by the water, and the two are automatically separated by gravitation, the air passing into a storage or supply chamber. The incredible statement is made that from 70 to 80 per cent. of the latent energy in the falling water can be rendered available in this manner. This is no more than a turbine yields, but the latter cannot transmit its energy to a distance within the interpolation of dynamos and motors in which some loss of power occurs. It is said a plant operating on this principle is to be installed at the Dominion Cotton Mills in Magog, near Montreal.

Kinetic energy is the energy of motion. Thus, if a fly-wheel is in rapid motion it possesses kinetic energy.

Potential energy is the possibility of doing work possessed by a body. If a heavy stone is placed at the top of a high building it possesses potential energy. If dislodged it will do work in falling. There is in the stone the possibility of work.

THE "ECONOMETER."

THE following is a description of an instrument, called the Econometer, designed to indicate permanently the conditions of combustion in boiler and other furnaces. This apparatus is designed to prevent a loss of heat resulting from an excessive amount of superfluous air passed through the furnace, and which has to be heated to the high temperature of the exit gases. If just as much air could be conveyed to the fuel as it needs for perfect combustion, the combustion gases would contain about 21 per cent. of CO_2 , as atmospheric air contains 21 per cent of oxygen. Carbonic acid being formed by the combustion of the carbon with the oxygen of the air, it follows that the percentage of CO_2 in the gases is larger the less superfluous air is admitted to the furnace. As this instrument shows continuously the amount of CO_2 in the gases, it is a permanent indicator to the stoker to regulate its firing according to its indications.

The Econometer consists of a finely adjusted balance

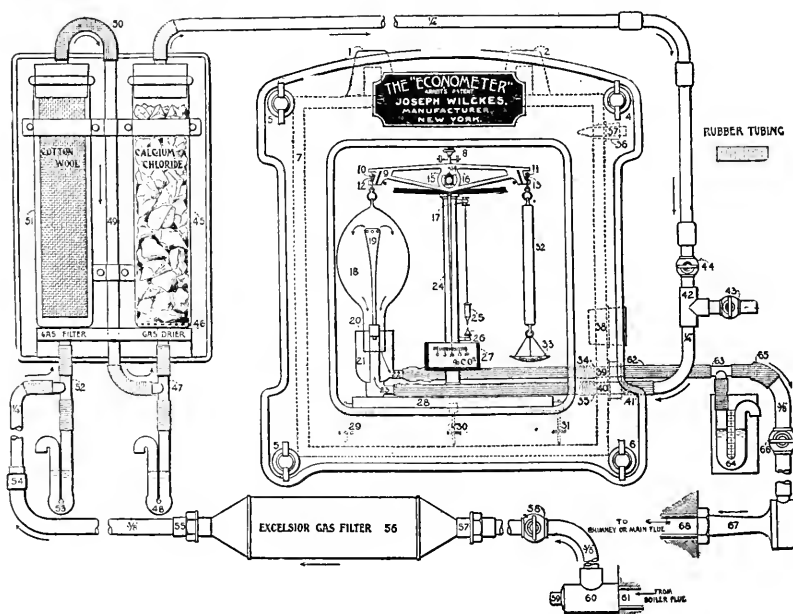
plus of air would be shown by lower readings. Thus the stoker is enabled by proper attention and regulation of the damper to get the best possible results from the fuel.

The Econometer is being introduced in the United States and Canada by Mr. Joseph Wilkes, of 106-108 Fulton street, New York. It is largely in use in most European countries, and several have also been installed in the United States.

Messrs H. McLaren & Co., 706 Craig street, Montreal, are the agents for Quebec and the eastern part of Ontario. They will be glad to give any further information.

DEVELOPING AN IMMENSE WATER POWER.

THE West Kootenay Power and Light Company, Limited, which was recently organized for the purpose of developing the magnificent water power available at the Falls of the Kootenay, in British Columbia, ten miles from Nelson, has just closed a contract for the hydraulic



enclosed in an iron case. The gases are taken from the boiler, led through two filters to retain the dust, and then passed through the drier to retain the moisture. The gases, perfectly clean and dry, enter the weighing globe 18. The CO_2 , being 50 per cent. heavier than atmospheric air, fills, mixed with the gases, the inside of this globe. The heavier its contents, the more it is lowered and the more the balance indicates. The gases enter by inlet pipe 23 and 19, and are drawn out by 22 to the chimney. The chimney suction increased by an aspirator 67 draws the gases continuously from the boiler. The Econometer is fitted in plain view of the stoker on a cool wall or board in order to cool the gases down to atmospheric temperature. The inside of the Econometer case is constantly supplied with sufficient air through air inlet 56 to be able to weigh CO_2 in air. This is also drawn off to the chimney through cup 21.

In practice proper firing means from 12 to 15 per cent. of carbonic acid in the combustion gases. A sur-

plus of air would be shown by lower readings. Thus the stoker is enabled by proper attention and regulation of the damper to get the best possible results from the fuel.

and electrical machinery, to develop 2,000 horse power immediately, the ultimate scope of the undertaking being the utilization of the full power of the river at this point, estimated at from 8,000 to 10,000 horse power. At the head of the company is Sir Charles Ross, Bart., who is largely interested in mining properties, and with him are associated Messrs. C. R. Hosmer, Frank Paul, and other influential and well known capitalists.

The services of Mr. Robert Jamieson, formerly engineer in charge of the Lilloet, Fraser River & Caribou Gold Fields Co., Limited, have been secured to supervise the entire undertaking, and his wide experience in mining engineering work of all kinds will insure the most efficient working out of all the detail appliances necessary to apply the electric power in the most satisfactory manner for mining work.

Some interesting details as to the electrical features of the scheme have been made known. The apparatus, which will be furnished by the Canadian General Elec-

tric Company, Limited, will be of the three-phase alternating type, similar to that now being installed in the large power plant of the Lachine Rapids Hydraulic & Land Company at Montreal. The initial generating plant will consist of two machines, of the revolving field and stationary armature type, having a capacity of 1,000 horse power each, from which the current will pass through step-up transformers, raising it to 20,000 volts, the highest pressure as yet used on any electric transmission line. At this high pressure the energy will be carried to a sub-station at Rossland, a distance of thirty miles, where it will be reduced to a pressure of 2,000 volts, for transmission to the motors used in connection with the different mining operations.

The electric power will be furnished for operating tramways, hoists, pumps, ventilators, stamp mills, compressors, drills, etc., and will be sold at a price which, in comparison with the present high cost of power generated from coal, means a greatly reduced expenditure in this direction by the different mining companies. The machinery is now in the course of construction and the plant is to be in full operation early in the fall.

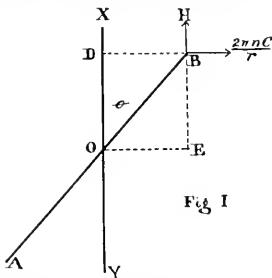
TORONTO TECHNICAL SCHOOL EXAMINATIONS.

As announced in our May issue, we publish below the answers to the Technical School examination questions in Electrical Engineering and Steam and the Steam Engine, as furnished by Mr. James Milne, lecturer in these subjects. The working of the problems in Electrical Engineering is shown in full, but in the case of Steam only the answers are given. Should any of our readers desire to see the working out of some of the most difficult of the questions we will be pleased to publish the same for our August issue. For the questions in Steam and the Steam Engine readers are referred to the May number of the ELECTRICAL NEWS.

ELECTRICAL ENGINEERING.

1. What data do you require for determining the amount of current as measured by the Tangent or Sine galvanometer? Work out the formula, and make the necessary sketches to illustrate your answer.

ANSWER.—Let XY represent the plane of the coil and needle lying in the magnetic meridian and suppose AOB to represent the direction the needle has assumed under the influence of the

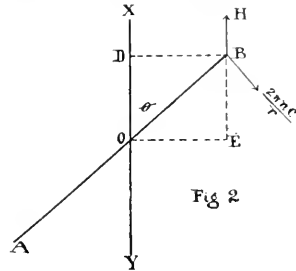


current. This direction will be the resultant of two forces, viz., the force $2\pi n C/r$ exerted by the current and the horizontal component of the earth's magnetism H . Since the needle is at rest the moments of these forces must be equal, i. e. $\frac{2\pi n C}{r} \times DO = H \times OE$ or $\frac{2\pi n C}{r} = H \frac{OE}{DO}$. But $OE = DB$ and $\frac{OE}{DO} = \tan \phi$, $\therefore \frac{2\pi n C}{r} = H \tan \phi$.

The quantity $\frac{2\pi n C}{r}$ is dependent on the form and size of the instrument. From the equation we see that the data necessary for determining the amount of current in the tangent galvanometer are

the values of n , r , H and the $\tan \phi$. Where n = No. of turns of wire, r = radius of the coil, and H = the horizontal component. In Toronto its value is about .1664 C. G. S. units.

In the sine galvanometer, instead of measuring the deflection as in the above, the coil is turned round so as to follow the needle, which, of course, deflects it still further; the coil is therefore turned still further round until finally the plane of the coil and the direction of the needles are once more parallel. In Fig. 2 let XY = the original position of the coil and needle in the magnetic meridian and AB



the final position of coil and needle. Then $2\pi n C/r$ will be the force tending to send needle at right angles to the plane of the coil, but H will tend to bring the needle back to the magnetic meridian. If the needle is at rest the moments about the centre O must be equal, i. e.

$$\begin{aligned} \frac{2\pi n C}{r} \times BO &= H \times EO \\ \text{or } \frac{2\pi n C}{r} &= H \frac{EO}{BO}, \text{ but } \frac{EO}{BO} = \frac{DB}{BO} = \sin \phi \text{ of deflection} \\ \therefore \frac{2\pi n C}{r} &= H \sin \phi \\ \text{or } C \text{ in C.G.S. units} &= \frac{H \sin \phi}{2\pi n} r \end{aligned}$$

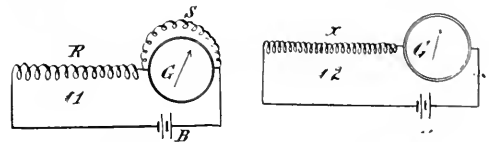
The data necessary being exactly the same as in the tangent galvanometer, the only exception being that the \sin is substituted for the \tan .

2. How would you determine the value of an unknown resistance if you were supplied with a Weston voltmeter, the resistance of which is known, together with a known E. M. F. and whatever wires, etc., are necessary for making the necessary connections? If voltmeter has 20,000 ohms R_v and the E. M. F. is 600 volts, when the unknown R is put in circuit voltmeter shows 375 volts, what is the value of the resistance?

ANSWER.—Unknown resistance 6666.6 ohms.

3. With a shunted galvanometer, when a resistance of .1 megohm was in circuit, a deflection of 10 was observed when battery key was pressed. With same battery and shunt removed, there was a deflection of 5 when a certain resistance was in the circuit. Determine the value of the resistance. The resistance of the galvanometer was 7,920 ohms, and the shunt was 1/90th. Omit in the calculation the battery resistance. Make a sketch of the arrangement, and show clearly how you arrive at your results.

ANSWER.—



$R = .1 \text{ meg.}$
 $G = 7,920 \text{ ohms.}$
 $S = 1/90 \text{ th.}$
 $d_1 = 10$
 $R = \text{Resistance of battery.}$

$X = \text{Unknown resistance.}$
 $G = 7,920 \text{ ohms.}$
 $d_2 = 5$
 $R = \text{Battery R.}$

$$\begin{aligned} C &= \frac{E}{R} = \frac{E}{R + \frac{G \cdot S}{G + S} + B} = k d_1 \frac{G \cdot S}{S} \\ E &= \left(R + \frac{G \cdot S}{G + S} + B \right) k d_1 \frac{G + S}{S} \quad (1) \end{aligned}$$

Without shunt we get

$$\begin{aligned} C &= \frac{E}{X + G + B} = k d_2 \\ E &= (X + G + B) k d_2 \quad (2) \end{aligned}$$

as E is the same in equation (1) as in (2) then

$$(X + G + B) k d_2 = \left(R + \frac{G S}{G + S} + B \right) k d_1 \frac{S}{G + S}$$

omitting B which is very small and cancelling k

$$(X + G) d_2 \left(R + \frac{G S}{G + S} \right) d_1 \frac{G + S}{S} \\ \therefore X = \left\{ \left(R + \frac{G S}{G + S} \right) d_1 \frac{G + S}{S} \right\} \frac{G}{d_2}$$

and substituting the values as given above we get

$$X = 20,007,920 \text{ ohms or } 20 \text{ megs. fully.}$$

4. The electro-chemical equivalent of zinc is .00034. What do you understand by this? What would be the deposit in an Edison chemical meter, the German silver shunt having a resistance of .01 ohms, and the resistance of the voltmeter and the coil in series with it being 48.06 ohms, when a current of 100 amperes has been passing for 4 hours. Make a diagram showing the arrangement.

ANSWER.—One coulomb deposits .00034 grams, = electro chemical equivalent.

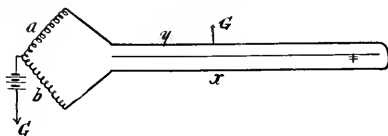
\therefore Amount of current \times electro chem. equivalent \times time in seconds = deposit.

In the question the resistances are as .01 : 48.06

$\therefore 1/4807 \text{ of } 400 \times .00034 \times 3600 = 100 \text{ milligrams will be the deposit.}$

5. In an Edison underground 3-wire system, the distance from power-house to feeder junction box is 6,000 feet. The copper resistance is .017 ohms per 1,000 feet. The two outside wires are looped together at one end (the junction box), and at the other the ends of the loop are attached to the terminals of the galvanometer. A 150-ohm resistance coil of 200 turns is also connected to the terminals of the galvanometer, and at a distance of 20 turns from one end one pole of a 4-cell battery is attached, the other pole being attached to ground. In this position there is no deflection of the needle. Find the location of the fault and give distance in feet from the power house.

ANSWER.—



$$a = 15 \text{ ohms.}$$

$$b = 135 \text{ ohms.}$$

$$l = \text{total length } x + y = .2040 \text{ ohms.}$$

$$x = l - y.$$

$$a x = b y.$$

$$a (l - y) = b y.$$

$$a l = y (a + b).$$

$$y = \frac{a l}{a + b} = .0204 \text{ ohms or } 1200 \text{ feet.}$$

6. What is the size of the conductor in the above question?

ANSWER.—Knowing that the resistance of one mil foot is 10.4 ohms we can easily find the diameter in mils.

$$\text{or } d = \sqrt{611.750} = 782 \text{ mils or } .782'' \text{ diameter.}$$

7. What data would you require to determine the permeability of an electro-magnet core which lifts a weight **P** pounds? Investigate a formula. What do you understand by permeability?

ANSWER.—The lifting power of a magnet in dynes is $\frac{B^2 A}{8\pi}$ where B = induction per square centimeter and A = area in square centimeters, from which we can easily get

$$B'' = \sqrt{\frac{\text{pull in lbs.}}{\text{area in square inches}}} \times 8494 \quad (1)$$

when B'' = lines of force per square inch.

The law of the magnetic circuit being

$$\text{magnetic flux} = N = \frac{\text{Magneto motive force}}{\text{Reluctance}} = \frac{4\pi \text{ Amp. turns}}{\frac{10}{A u}}$$

$$= \frac{4\pi \text{ Amp. turns} \times A u}{10} \text{ for centimeter measurement,}$$

from which we get

$$N = \frac{3.2 \text{ amp. turns} \times A'' u}{l''} \text{ for inch measurement}$$

when A'' = area in square inches.

l'' = length in inches.

u = permeability.

$$\frac{N}{A''} = B'' = \frac{3.2 \text{ amp. turns} \times u}{l''}$$

$$\text{But in (1) } B'' = \sqrt{\frac{\text{lbs.}}{\text{area}}} \times 8494$$

$$\therefore \frac{3.2 \text{ amp turns} \times u}{l''} = \sqrt{\frac{\text{lbs.}}{\text{area}}} \times 8494$$

from which we get

$$u = \sqrt{\frac{\text{lbs.}}{\text{area}}} \times \frac{l''}{\text{amp. turns}} \times 2660$$

From this equation we see that the data necessary for determining the permeability, u, the specific conductivity for magnetic lines or multiplying power of the material which lifts a weight of **P** lbs. will be the following: The area in square inches of the magnet, the length of the core in inches and the number of ampere turns.

8. A current of 20 amperes, flowing through a resistance of 10 ohms, heats 20 lbs. of water from 60° to 70° Fah. How long was current flowing, supposing there was no loss by radiation?

ANSWER.—Let J = Joules mechanical equivalent.

H = No. of heat units.

1 lb. deg. Fah. = 1047.3 watts.

J H = Work done = C² R t

where t = time in seconds

$$\therefore t = \frac{J H}{C^2 R} = \frac{1047.3 \times 20 (70 - 60)}{20 \times 20 \times 10} \\ = 52.4 \text{ seconds nearly.}$$

9. What is the efficiency of an electric motor when running up to its maximum? Prove it.

ANSWER.—When motor is standing still the current that will flow through the winding will be $\frac{E}{R}$ where E = E M F of supply and when running

$$C = \frac{E - \text{counter E M F}}{R}$$

Useful work = C \times counter E M F = counter E M F $\left(\frac{E - C \cdot E M F}{R} \right)$

Work spent in heating the conductors = C² R

Total watts = E C = C² R + C \times counter E M F

$$= C^2 R + \text{counter E M F} \left(\frac{E - C \cdot E M F}{R} \right)$$

$$\text{but } C^2 R = C \times \text{counter E M F}$$

$$\therefore E \cdot C = 2 C^2 R$$

$$E = 2 C R$$

$$C = \frac{E}{2 R}$$

which shows that one-half the total power supplied is spent in heating the wires, and that the mechanical work given out by the motor is a maximum when the current is reduced to one-half the strength it would be if the motor was standing, and its efficiency is therefore $\frac{1}{2}$ or 50%.

10. Describe the Aron or Thomson wattmeter.

ANSWER.—The Thomson wattmeter is sufficiently well known that no description here is necessary. The following may prove interesting to some regarding the Aron meter.

Let E = E M F at service

C = current

T = term of one oscillation of correct clock

T = " " " " retarded "

g = gravity

C · E H = magnetic force

l = length of pendulum

$$T = \pi \sqrt{\frac{l}{g}} \quad T_1 = \pi \sqrt{\frac{l}{g - C \cdot E \cdot H}}$$

$$\frac{T}{T_1} = \frac{\pi \sqrt{\frac{l}{g}}}{\pi \sqrt{\frac{l}{g - C \cdot E \cdot H}}} = \frac{\sqrt{\frac{l}{g}}}{\sqrt{\frac{l}{g - C \cdot E \cdot H}}}$$

$$\left(\frac{T}{T_1} \right)^2 = \frac{1}{\frac{g - C \cdot E \cdot H}{g}} = \frac{1}{1 - \frac{C \cdot E \cdot H}{g}}$$

$$\left(\frac{T}{T_1} \right)^2 = \frac{1 - C \cdot E \cdot H}{g} \text{ or } \frac{T}{T_1} = \sqrt{1 - \frac{C \cdot E \cdot H}{g}}$$

So that this meter will record accurately the magnetic force, which should be very small compared with gravity, therefore $\frac{C \cdot E \cdot H}{g}$ must also be very small compared with unity.

$$\therefore \left(1 - \frac{C \cdot E \cdot H}{g} \right)^{\frac{1}{2}} = \left(1 - \frac{C \cdot E \cdot H}{2 g} \right) \text{ very nearly}$$

or $\frac{T}{T_1} = \frac{1 - C \cdot E \cdot H}{2g}$ nearly, or the rate of loss in the second

clock equals $\frac{C \cdot E \cdot H}{2g}$ which is directly proportional to $C \cdot E$.

11. Make a diagram showing the connections in the Brush or Thomson-Houston arc dynamos. Make sufficient sketches to fully illustrate the changes that take place in one revolution. Also describe some form of regulator for arc machines.

ANS.—A detailed description of this is not necessary here.

12. What does the torque of a motor depend on? Prove your statement.

ANS.— $E \cdot X \cdot C = 2\pi n T \times 1.356$.

When T = torque in pound feet and the multiple 1.356 is to bring pound feet to watts.

But E is proportioned to the speed if the flux X is constant, or

$$E = \frac{n N c}{10^8} \quad \text{where}$$

n = revs. per second. Nc = No. of conductors.

If we substitute this value of E in the first equation we get

$$\frac{n N c}{10^8} \cdot C = 2\pi n T \times 1.356$$

$$\frac{N c}{10^8} \cdot C = 2\pi T \times 1.356$$

$$T = \frac{N c \cdot n \cdot C}{10^8 \times 8.52}$$

Showing that the torque depends only on the current and the flux N .

13. What do you understand by the "Constant" of a galvanometer? What data do you require in determining it? Give an example and show clearly what is meant by it.

ANS.—Take the first sketch in question No. 3, together with the same data.

$$R = \text{Total Resistance} = (.1 \text{ meg} + \frac{G \cdot S}{G + S} - B)$$

$$= (100,000 + \frac{G \cdot S}{G + S} - B)$$

Galvanometer Constant = Degrees deflection \times power of shunt $\times R$

$$= d \left(\frac{G + S}{S} \right) R$$

$$= 10 \times (100,000 + \frac{7920 + 80}{8000} + B)$$

and if we assume $B = 200$

then Constant = 100,279,200 ohms

or Constant in megohms = 100.28.

This number represents the deflection that would be produced on the scale if there was 1 megohm in circuit, if no shunt was used; or if 1 ohm was in circuit there would be 100,280,000 degrees deflection.

Example showing the working after constant has been determined:

Cable 200 miles, deflection 100°, constant 100.28; what is the R ?

$$R \text{ of cable} = \frac{100 \cdot 28}{d} = 1,0028 \text{ megs.}$$

Resistance per mile = 200.56 megs.

STEAM AND THE STEAM ENGINE.

ELEMENTARY.

ANS. 1. 138960 ft. pds. 746215.2 ft. pds.

2. Cut-off 1/5th stroke. 16.1 lbs. M.E.P.

4. 17 in. diam.

5. 70 lbs. nearly.

6. 1571 sq. feet; 524 h.p.

8. (1) 1; (2) 1.8; (3) 2.7

$$10. h = \frac{G}{4\pi^2 n^2} = 6 \text{ in.}$$

11. 68% lost.

ADVANCED.

12. 1 1/8 in. open to steam; full port opening to exhaust, the edge of the valve travelling 3/16 in. past the edge of the post.

13. This was intended to be solved graphically, by Dr. Zeuners method. The accompanying diagram shows how the positions are arrived at, from which it is seen that the piston is 1/8 in. from end of stroke when admission takes place; 18.4 in. at cut-off; 23 in. when exhaust opens and 4 1/8 in. at compression.

[The last part of the question has been omitted, as it will not affect the working. Further explanation to those desiring same will be freely given.—J. M.]

14. 23.45 I.H.P.; 18.57 B.H.P.; .79 efficiency.

15. 25.9 lbs. water.

17. 14.3 lbs. difference in M.E.P.

18. Would take too much space to answer.

19. Pitch = 2.186 in., 3.328 in. and 4.47 in. for single, double and triple rivetted joints respectively. Diam. of rivets 1.044 in. Strength of joints as compared with original plate—.52 for single, .69 for double, and .77 for triple rivetted joint.

20. 417 lbs. per sq. in. for longitudinal and 1534 lbs. per sq. in. for transverse seams.

21. As no tables are allowed at the examination the total heat must be calculated from the data given. Boiler efficiency .8; h.p. = 123; 10.6 lbs. equivalent evaporation; from and at 212 in.; 13.5% gain.

22. M.E.P. on high press. cyl. 60 lbs.; M.E.P. on intermed. cyl. 24 and 10 lbs. M.E.P. on the low press.; diam. of h.p. piston 29 3/8 in., intermediate 46 1/2 in., low press. 72 in.

23. 178 h.p.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Hull, Que., writes: What is the indicated horse power of an 8 \times 10 non-condensing engine running 125 revolutions per minute, steam pressure at 100 lbs., cutting off at half stroke? Also what is the average pressure throughout the stroke?

ANSWER.—We will assume that the above pressure signifies gauge pressure, which gives us 115 lbs. absolute, and that the back pressure is 5 lbs. above atmosphere or 20 lbs. absolute, then the

Mean effective pressure =

$$\text{Initial pressure} \left(1 - \frac{\text{hyp. log of } R}{R} \right) - \text{back pressure}$$

where R = Ratio of expansion =

$$\frac{\text{Length of stroke} + \text{clearance}}{\text{Distance travelled by piston before steam is cut off} + \text{clearance}}$$

or leaving clearance out of the calculation, we get

$$R = \frac{\text{Length of stroke}}{\text{Distance travelled by piston before steam is cut off}} = \frac{10}{5} = 2$$

$$\therefore \text{M.E.P.} = 115 \left(\frac{1 - \text{hyp. log } 2}{2} \right) - 20 = 77.3475 \text{ lbs.}$$

To find the horse power

$$\text{H.P.} = \frac{2 R A P S}{33000}$$

Where R = Revs. per minute.

A = Area of piston in square inches.

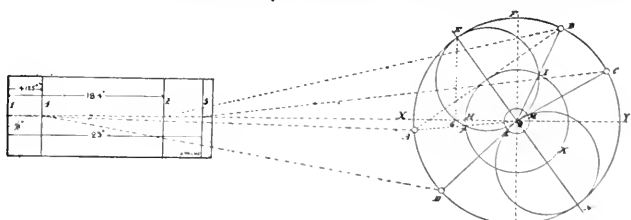
P = M.E.P. as found above.

S = Length of stroke in feet = 1 1/2'.

$$\text{or } \frac{2 + 125 \times 50.26 \times 77.3475 \times 10}{33000 \times 42} = 24.54 \text{ h.p.}$$

"J. A. G.," Peterboro', Ont., asks: On a three-phase synchronous motor, carrying a standing load to increase the field current, thereby increasing the E. M. F., the current remaining the same, how is the increased energy accounted for, the speed remaining the same?

ANSWER.—If you really mean an "asynchronous" motor, then your question is impossible of answer. "Asynchronous" is the same practically as "induction" motor, which permits of no more field variation than



any other transformer, static or rotary. If, however, you mean "synchronous" motor, which is practically a generator used as a motor, then of course you know that the fields are separately excited, and only the armature coils supplied by the line currents. In this case the synchronous motor will produce a counter E.M.F. like in any D. C. motor, which counter E.M.F. may be made less or greater than the impressed line E.M.F. by varying the exciting field current. This back E.M.F. may be made to take the place of a negative reactance, having a condenser effect, and tending to produce a leading current, which, however, being wattless, takes no energy. This is probably what you want to know.

APPLIED MECHANICS.

The following is a copy of the examination paper in Applied Mechanics submitted to the students of the Toronto Technical School at the closing of the 1896-97 term. Solutions of the questions, as worked out by the examiner, Mr. James Milne, will be given in our August issue:

ELEMENTARY.

1. State the principle of a lever, and prove it when P and W act on opposite sides of the fulcrum. A weight of 5 lbs. is hung at one end of a uniform bar, which is balanced over a knife edge at a point of 14 in. from the end at which the weight hangs. If the bar weighs 30 lbs., find its length.
2. Define kinetic energy. How does it differ from potential energy? If a velocity of 300 feet per second is impressed upon a weight of 10 lbs., what is the measure of the energy now imparted to the weight?
3. What is the modulus of elasticity of a substance? A round bar of iron, 12 feet long and $1\frac{1}{2}$ square inches in area, is held at one end, and pulled by a force till it stretches $\frac{1}{8}$ in. Find the force, the modulus of elasticity being 30,000,000.
4. What do you understand by the efficiency of a machine, and how is it measured? In a single purchase crab, the pinion has 12 teeth and the wheel 78 teeth, the diameter of the barrel being 7 inches and the length of the lever handle 14 inches. It is found that the application of a force of 15 lbs. at the end of the handle suffices to raise a weight of 280 lbs. Find the efficiency of the machine.
5. A cubical box or tank with a closed lid, the length of a side being 4 feet, rests with its base horizontal, and an open vertical pipe enters one of its sides by an elbow. The tank is full of water, and the pipe contains water to a height of 1 foot above the top of the tank. What are the pressures on the top, bottom and sides of the tank?
6. A beam of timber rectangular in transverse section is 2 in. broad, 3 in. deep, and 4 ft. long, and rests upon supports at its ends. The breaking load at its centre is 2,000 lbs. What would be the breaking weight if the beam had been 4 in. deep, 2 in. broad, and 4 ft. between supports, but loaded at a distance of 1 ft. from the end?
7. What is the "pitch" of a tooth of a spur wheel? Two parallel shafts whose axes are to be as nearly as possible 2 ft. 6 in. apart, are to be connected by a pair of spur wheels, so that while the driver runs at 100 revolutions per minute, the follower is required to run at 25 revolutions per minute. Calculate the diameters of the wheels, and, supposing the pitch to be $1\frac{1}{4}$ inches, ascertain the number of teeth in each wheel.
8. A uniform beam weighing 1 ton rests on supports at its ends 20 feet apart. Weights, 5, 10 and 15 cwt., rest on the beam at a distance of 6 feet apart, and the weight of 5 cwt. being 4 feet from one end, and the 15 cwt. 4 feet from the other. Find the reactions at the supports and the centre of gravity.
9. A safety valve $3\frac{1}{2}$ in. diameter; steam pressure 80 lbs. per square inch; from vulcurn to centre of valve $3\frac{1}{2}$ in.; lever 30 in. long, and weighs 10 lbs.; centre of gravity of lever 10 in. from fulcrum; weight of valve 3 lbs. What weight is required at end of lever so that steam will just blow off?
10. Friction being neglected, find the force which will support 1 ton on an incline of 1 foot vertical and 10 feet along the incline. If the incline were 1 foot vertical and 280 feet along the incline, find the force in lbs. that would support 1 ton.
11. The accumulated work of one pound of gunpowder is 70 foot tons. Find the amount necessary to project a shot of 5 cwt. at a velocity of 1,000 feet per second. If the charge were 100 lbs., find the weight projected at the above velocity.
12. A locomotive together with train weighs 100 tons and runs at the speed of 30 miles per hour on a level rail. Find the horse-power if friction is 8 lbs. per ton. If the rails had an incline of 1 per cent., what additional horse-power would be required?

ADVANCED.

13. In a Weston pulley block the sheaves are 9 inches and $8\frac{1}{2}$ in. diameter. What weight could be lifted (neglecting friction) by a pull of 50 lbs. on the chain? Since in this block the weight remains suspended when there is no pull on the chain, what do you infer as to the limit of efficiency? How would you determine the actual efficiency of the apparatus?
14. The foot of a uniform derrick pole weighing 2 cwt., rests on the ground, and the pole carries a weight of $1\frac{1}{2}$ tons suspended from its upper extremity. The length of the pole is 20 feet, and is kept in position by a guy rope fastened to the ground 10 feet to the rear of the foot of the pole, and 25 feet in length. Find by calculation the tension on the guy rope, and by construction the thrust on the jib.
15. A wooden beam, 12 in. deep, 6 in. wide, and 12 ft. long, is imbedded in a wall at one end. What weight will the beam carry at the outer end, if the B. W. of a beam 1 ft. long, 1 in. x 1 in., supported at the ends and loaded at the centre, is 500 lbs.? What is the shearing force.
16. The table of a drilling machine is raised and lowered by a single threaded worm and worm-wheel in combination with a rack and pinion. A pressure of 10 lbs. is applied at the end of the handle, which is 12 in. long. The worm-wheel has 24 teeth, and the rack pinion has a pitch circle of 2 in. radius. What weight placed on the table would be balanced under these conditions, supposing that 50 per cent. of the work applied is lost in friction, and that the table together with the moving attachments weigh 5 cwt.?
17. Draw an isosceles triangle with the vertex angle at 120° , trisect the base, join the points of trisection with the vertex, and draw perpendiculars from the points of trisection upon the sides nearest to them.

Regarding the figure as a roof truss with a load of 2,000 lbs. upon each rafter, whereof 1,000 lbs. is carried at the middle joint. Find, by calculation or otherwise, the stresses on the various members.

18. Determine the horse power which may be transmitted by a leather belt 36 in. wide and $\frac{3}{8}$ -in. thick, running at 80 ft. per second, the tension on the slack side being $\frac{4}{10}$ ths that on the tight side, and the maximum strength allowed 300 lbs. per square inch.

19. Taking the weight of a cubic foot of leather to be 60 lbs., determine the effects due to centrifugal force in the above question.

20. A shaft, having a stepped cone, revolves at a constant speed of 200 revolutions a minute, and is connected by means of a crossed belt. The diameter of the largest step is 14 inches. The driven shaft is required to run at speeds of 250, 175, 130 and 90 revolutions per minute. Determine the diameter of all remaining steps of the two cones, and also the length of the belt required if the distance between the centres of the shafts is 10 feet.

21. A uniform platform A B, weighing 3 cwt., is supported at B by a hinge. At A a 20 foot chain is attached and hung from a hook vertically above B. A weight of 10 cwt. is placed 2 feet from A. If the distance A B is 12 feet, find the tension of the chain and the direction and magnitude of the reaction at the hinge.

22. In an epicyclic train consisting of three wheels, the first is a dead one, consisting of 60 teeth, and the second has 30 teeth, and the third 40 teeth. Ascertain the number of revolutions the second and third wheels make for each revolution of the arm, together with the direction of same relative to the arm. If the wheel of 60 teeth makes 2 revolutions in the same time as the arm makes 1 revolution, but in the opposite direction, determine the number of revolutions of the second and third wheels.

23. A locomotive weighs 15 tons, and one-third of this weight rests on the driving-wheels. The coefficient of friction being $\frac{1}{75}$ between the wheels and the rail, what load will the engine draw on the level if coefficient of traction be 8 lbs. per ton? What load would the engine draw up a 4 per cent. grade at the same speed?

24. The diameter of a fly wheel is 20 feet; depth of rim 12 in.; width of rim 18 in. Running at 80 revolutions per minute. Find the centrifugal force and bursting stress. A cubic foot of cast-iron weighs 450 lbs. Take the radius of gyration as being 9.5 feet.

25. What would be the maximum number of revolutions the above wheel could make per minute, taking the tensile strength of good cast-iron as being 20,000 lbs. per square inch.

PATENTS FOR ELECTRICAL DEVICES.

PATENTS have been granted in Canada for the following devices: Canadian General Electric Co., Toronto, electric circuit controller; W. W. Jacques, Newton, Mass., electric power converter; M. Rangey and Peter Plante, Schenectady, N. Y., trolley switch; W. J. Greene, Cedar Rapids, Iowa, automatic cut-out for electrical transmission; Canadian General Electric Co., Toronto, regulator for alternating current circuits; Bell Telephone Co., telephone circuit; G. L. Campbell, Kinsman, Ont., dynamo electric machine; H. A. Parrish, Jackson, Mich., electric trolley signals for railways; Wm. Rosco Smith, Manchester, N. H., electric heating apparatus; Canadian General Electric Co., Toronto, electric brake; Fred. Green, Hull, Que., electrical thermostat; J. J. Teetzel, St. Thomas, Ont., air brake; G. J. Scott and W. S. Janney, Pennsylvania, system of electric distribution; J. A. Gowans, J. S. Fuller and M. Macfarlane, Stratford, Ont., electric annunciator.

CORRECTION.

IN connection with the new schedule of rates adopted by the Inland Revenue department for the inspection of electric light meters, and published in our last issue, a light was said to mean a 16 candle-power lamp consuming electrical energy at the rate of 15 watts. This should have been 55 watts.

WANTS IT OFTENER.

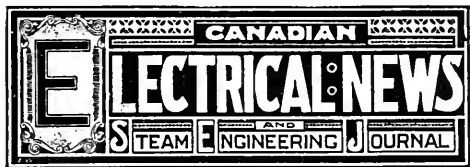
MR. Chas. E. Taylor, Sault St. Marie, Ont., in renewing his subscription to THE NEWS, writes: "Switch it in again; I hope soon to see it twice a month."

Is your piston rod in line, or are you a good customer for the packing man?

Are your belts running with as little tension as possible, and thus avoiding excessive friction?

It is a good idea to be as economical as possible in the use of oil, but it does not pay to attempt to run an engine with an insufficient quantity of cylinder oil, for not only will the cylinder be ruined, but you will use extra oil enough to much more than pay for all the cylinder oil needed.

Paper telegraph poles are the latest development in the art of making paper useful. These poles are made of paper pulp, in which borax, tallow, etc., are mixed in small quantities. The paper poles are said to be lighter and stronger than those of wood, and to be unaffected by sun, rain, dampness, or any of the other causes which shorten the life of a wooden pole.



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Regulating Devices for Steam engines with automatic variable cut-offs were the outcome of a demand for constant speed of rotation to be maintained on shafting driving fluctuating loads; and high speed, automatic cut-off engines were more especially the outcome of a demand for a prime mover to actuate high speed electrical machinery without countershafting. But, because automatic cut-off engines were specially designed for use in electric service is no reason why they should invariably be used, without reference to the conditions of a particular case, unless those conditions are such as to call for them. As automatic cut-offs were designed to meet the conditions imposed by a rapidly fluctuating load, where the load is practically constant, as in most smaller central stations on their arc systems, it will be evident that a less expensive and complicated type of engine will suffice. Even in incandescent systems a little observation will show the engineer at which time he may expect an increase in his load, and he can then meet it by opening the throttle a little wider. In a lighting plant, although, of course, the load varies greatly between the early part of the night and the morning hours, still the variations are not of the character of fluctuations in a railway plant, but a gradual increase and decrease which may be accurately predicted and thus allowed for. On an arc load this variation almost entirely disappears, and therefore the necessity for any close regulation. What is really required is a good constant steam pressure, and then any good engine may be expected to give satisfactory service without expensive centrifugal speed regulating devices. Similarly with compounding devices for generators, it is often claimed that a generator so wound as to over-compound to some definite percentage at full load is so much a better machine for central station use as to justify a great increase of price over that of a machine the pressure of which can be regulated only by hand. Where the load rapidly fluctuates up and down, as in a railway plant, this is quite

reasonable, but in a purely lighting plant, where it increases and decreases slowly and regularly, the necessary voltage adjustments can be made by hand quite satisfactorily. It is a great mistake to base the details of any new plant merely on conventional practice, without regard to special conditions which are presented by everyone; the more carefully any case is studied the greater is likely to be the economy in first cost, and in subsequent operation.

Efficiency of Transformers.

FOLLOWING our remarks in last month's issue on the subject of transformer losses, we have seen results of a test recently made by an unbiased engineer on a number of transformers of Canadian make. They were all new, and of sizes varying from 1,250 watts to 5,000 watts. Between the best and the worst of the former size there was found a difference of 34.1 watts of core losses; between the best and worst of the 2,500 watt size there was a difference of 60 watts core loss; between the best and worst of the 5,000 watts a difference of 16 watts core loss and 37 watts copper loss. These losses mean coal wasted, and placed on a reasonable basis show that the transformers with the lower losses in the above cases were worth more as investments than the others by \$25, \$35, and \$15.25, for the respective sizes as above; that is to say, that the better transformers at \$50, \$70, and \$30.50 were just as good investments as the worst at \$25, \$35, and \$15.25, and at any lower prices were distinctly better investments. This is not a supposition case, but an actual occurrence, and should be an object lesson of great value to the large class of purchasers who are guided by price more than intrinsic value. We quote from a report of Prof. Jackson, who after giving a table of such core losses, etc., as may reasonably be allowed on transformers of various wattages, says, "The guarantees outlined may be easily met by any transformer manufacturer who builds safe and economical transformers, and they are now met by a number of makers. Transformers that do not meet the insulation and heating guarantees are unsafe to use upon commercial electric lighting or motor circuits, while those that do not meet the iron loss, regulation, and exciting current guarantees waste the company's money."

Merits of Transmission Systems.

At a time when the long distance transmission of power by electrical means is being very eagerly discussed, and attention drawn towards the various polyphasic systems as rendering such possible, one is rather apt to be carried away by the enthusiasm of the moment and believe that only by the use of high voltage polyphase currents is it practicable to transmit over great distances with a reasonable expenditure. It is, however, not only interesting but also instructive to observe that in Europe, where, as is admitted by unprejudiced American engineers, engineering is more thorough and probably better than on this side of the Atlantic, a considerable number of quite important transmission enterprises have adopted the continuous current series system; placing as many separate machines in series as may be necessary to generate a high difference of potential, which in some cases has been so great as 14,000 volts, used with success. The series system is, of course, adopted throughout, necessarily, all motors being also in series on the same circuit as the generators. Constant

current series machines are now being built both in Europe and America of very much larger size than was considered possible a few years ago; five years ago a 50-light arc machine was thought to be the limit—generating a difference of pressure of about 2,500 volts; now the most prominent makers guarantee machines with a capacity of 125 lights, or 6,250 volts. There are no doubt certain grave objections to the series method of transmission, but, as compared with the high voltage, polyphase alternating method, it presents some evident advantages. The disadvantages may be said to be the necessity of generating at once the full pressure used on the system, instead of being able to generate a low one on the machines, which can be raised by means of step-up transformers; the impossibility of using the simple induction motor; and the necessarily more complex current and speed regulating devices for both generators and motors. Against these may be placed the higher resultant efficiency of the total series plant as compared with the resultant efficiency of an alternative system, by the elimination of all losses due to capacity and inductance in the transmission wires, and those due to hysteresis, and lag in both transformers and induction motors. The difficulty of constructing continuous current machines for such high voltage is overcome by first-class methods and materials, and the entire practicability of this method of transmission seems to be vouched for by the fact that for four years it has been in continuous operation under a pressure of 3,500 volts per machine, and that quantities of power up to 1,200 h.p. are daily being transmitted over distances up to 20 miles, in Switzerland, Hungary and France, and are being utilized freely and satisfactorily in units so small as 2 h.p. We shall hope to see this system introduced shortly into Canada, where we have so many large water powers.

CONGRATULATIONS TO MR. FREDERIC NICHOLLS.

THE recent meeting of the National Electric Light Association of the United States held at Niagara Falls, N. Y., is unanimously considered by the electrical press, voicing the sentiments of those in attendance, to have been the most successful from all points of view in the history of the Association. The credit for this successful meeting, as well as for the excellent work done by the Association during the current year, is evidently regarded as being in a very large measure due to the work of the President, Mr. Frederic Nicholls, general manager of the Canadian General Electric Co., as the following resolution clearly shows:

At the twentieth Convention of The National Electric Light Association, held at Niagara Falls, New York, June 10th, 1897, the following preambles and resolutions were unanimously adopted:—

Whereas The National Electric Light Association has during the past year, and at this its twentieth convention, achieved unequalled success, it is hereby resolved—That the congratulations of the Association be and are hereby extended to Mr. Frederic Nicholls, its President for this year, upon the brilliant results attending his administration of its affairs.

Resolved, that Mr. Nicholls be complimented especially upon the exemplary zeal and untiring energy with which he sought and found opportunities for the Association's greater usefulness, and made the organization more than ever a power for good in the light and power industry, and among the local central stations of the country.

Resolved, that in particular Mr. Nicholls be felicitated upon the cheering triumph, during his memorable term of office, of the Association's long continued endeavor to secure an authoritative

national code of wiring rules, upon the movement to standardize incandescent lamps, and upon the remarkable stability in funds and membership with which his period of presidential service closed.

Resolved, that these expressions of heartiest esteem and goodwill towards one for so many years an official of the Association be appropriately engrossed and presented by the Secretary to Mr. Nicholls.

(Signed) SAMUEL INSULL, President.

(Signed) GEO. F. PORTER, Secretary.

TEST OF THE TORONTO RAILWAY COMPANY'S BOILERS.

THE accompanying table gives the results of a set of tests made by Mr. George H. Barrus, of Boston, on the boilers of the Toronto Railway Company's plant, to determine the economy due to the use of Green's economiser.

This plant embraces six boilers of the Scotch marine type, the dimensions of which are 10 ft. in diameter and 14 ft. in length. Each boiler is fitted with Fox corrugated furnaces, provided with grates 6 ft. long and 3 ft. wide, and each has 80 4-in. tubes running from end to end. The area of grate surface in each boiler is 86 sq. ft., about 40 per cent. of which is air-space, and the area of heating surface is approximately 1,500 sq. ft. The whole plant of six boilers has 216 sq. ft. of grate surface, and approximately 9,000 sq. ft. of heating surface. Steam is used by a number of engines which furnish power for generating the electric current used by the railway. The plant is in operation, under its normal conditions of work, for a period of about 18½ hours each day. During this period the average amount of current generated is some 2,400 amperes, at a pressure of 550 volts. For the remaining period of 5½ hours the load ranges from 80 to 280 amperes, one of the smaller engines being in use during the greater portion of this time. During the night period two of the boilers are kept in continuous operation, but the fires in the remaining boilers are banked. At the time of the tests all the six boilers were in operation, and the fuel used was a mixture of Pittsburg slack coal and pea and dust anthracite from the mine, in the proportions of two loads of the former to one of the latter. The fires were cleaned three times during the full run of 24 hours. At times of the heaviest load the plant required the assistance of some of the old boilers of the station.

The fuel used on the tests was that commonly burned, that is, a mixture of Pittsburg slack and pea and dust from the mine. The proportions were approximately 66.5 per cent. of the former and 33.5 per cent. of the latter on both tests. The calorific value of a sample of this coal, as determined in Barrus's calorimeter, is 13,121 B.T.U. per pound of coal, and 14,875 B.T.U. per pound of combustible, the ash being 11.8 per cent. The spreading system of firing was employed, the thickness of the bed of coal being about 6 in., and the fires were frequently broken up and levelled off. During the progress of the tests the regulating damper in the main flue was constantly wide open, and at both tests the boilers were run at practically full capacity.

On the test with the economiser in use 6,510 lbs. of coal were used by the old boilers, and on the test without the economiser 20,390 lbs. The water supplied to the old boilers was not measured. These boilers have no connection with the economiser, and consequently their work had no direct bearing upon the main test. The coal which they consumed, here noted, is in addition to that recorded in the table. The saving due to

the economiser is shown to represent 18.3 per cent. of the coal required when the economiser was not in use, and amounted for a day's run to 21,385 lbs., or 10.7 tons of coal. The efficiency of the plant or the percentage which the heat utilized bears to the calorific value of the coal when the economiser was in use, was 70.6 per cent. It may be added here that the maximum temperature of the water leaving the economiser during the trial was 253 degrees.

DATA AND RESULTS OF EVAPORATIVE TESTS ON TORONTO RAILWAY COMPANY'S BOILERS.

Conditions as to Running of Economiser.	Economiser running.	Economiser not running.
1. Duration.....hrs.	19.66	19.72
2. Weight of dry coal consumed...lb.	95,310	104,372
3. Weight of ashes and clinkers...lb.	14,417	15,932
4. Percentage of ashes and clinkers.....per cent.	15.1	15.3
5. Weight of water evaporated...lb.	788,717	702,610
HOURLY QUANTITIES.		
6. Coal consumed per hour.....lb.	4,847.9	5,292.7
7. Coal per hour per square foot of grate.....lb.	22.4	24.5
8. Water evaporated per hour.....lb.	40,113	35,634
9. Equivalent evaporation per hour, feed 100 deg., press. 70 lb.....lb.	40,435	36,602
10. Horse-power developed, A.S.M.E. basis of 30 lb.....h.p.	1,347.8	1,202
AVERAGES OF OBSERVATIONS, &c.		
11. Average boiler pressure.....lb.	120.3	119.3
12. Average temperature of feedwater at point of entering economiser.....deg.	101	96.4
13. Average temperature of feedwater at point of leaving economiser.....deg.	237	...
14. Average temperature of flue gases at point of entering economiser.....deg.	620	607
15. Average temperature of flue gases at point of leaving economiser.....deg.	293	...
16. Average draught suction in main flue near boilers.....in.	0.83	1.16
17. Weather and outside temperature	Clear Moderate	Cloudy Moderate
RESULTS.		
18. Water evaporated per lb. of coal...lb.	8.275	6.731
19. Equivalent evaporation per lb. of coal from and at 212 deg.....lb.	9.586	7.828
20. Equivalent evaporation per lb. of combustible from and at 212 deg...lb.	11.291	9.243
21. Weight of dry coal required to evaporate 788,717 lb. of water supplied at 10 deg. (for 24 hours' run) based on above results.....lb.	95,310	116,605
22. Saving of coal due to economiser for 24 hours' run.....lb.	21,385	...
23. Percentage of saving due to economiser.....per cent.	18.3	...

NOTE.—The temperature of the flue gases here given does not include the night period from 12 midnight to 6 a.m.

PERSONAL.

Mr. Ormond Higman, Chief of the Electrical Inspection Department of the Dominion Government, returned last month from British Columbia and the Northwest Territories, having been absent several weeks. While there Mr. Higman established offices and appointed inspectors for these districts to inspect electric light meters, in accordance with the Electric Light Inspection Act. He advises us that the gas inspectors have been commissioned to act in this capacity, as was the case in the eastern provinces.

Mr. W. McLea Walbank, managing director of the Lachine Rapids Hydraulic & Land Co., has been elected a member of the executive committee of the National Electric Light Association of the United States. As the holding of the executive offices in the association is an honor very much sought after, the election of Mr. Walbank to the executive committee following the occupancy of the president's chair by Mr. Frederic Nicholls, is an appreciative recognition of the importance of Canadian electrical interests on the part of our American confederates.

WHY SOME LIGHTING PLANTS DO NOT PAY.

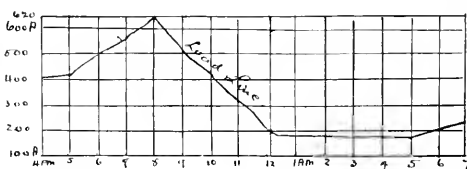
BY GEORGE WHITE-FRASER.

At the last convention of the Canadian Electrical Association there were some very valuable papers presented; valuable not only in themselves, but because of the discussions they gave rise to. Probably that one presenting features of most practical interest to central station owners was Mr. Armstrong's, on the above subject, and while necessarily limited to more general indications as to the reasons for failure to produce dividends, many points were made of great importance. Mr. Armstrong, in his last paragraph, states that he had intended to take up the subject of "engineering and operation, taking up, first, the question of selection of apparatus, etc., and considering how far deviations from such an ideal installation were responsible for failure to get best results in a given case." Although this part of the subject seems thus to be considered of secondary importance, I think it really deserves to be placed before the other. I think it will be at once admitted that for each case there is a certain amount and combination of machinery, lines, etc., that will best and most efficiently perform the work, and that any deviation from this best combination will introduce an inefficiency into the working. It follows, therefore, that a poor, or even moderately injudicious design or combination, will impose on the plant an inefficiency that can never be overcome, even by the most intelligent, educated management. Once a plant is bought and installed, there's an end of it; it has got to be operated just as it is; and any little expense arising from the very many possible errors in design of a plant containing both the steam and electrical machinery will be a yearly loss just as long as the plant continues to operate in that state. You can engage an inexperienced engineer, and he can learn; you cannot teach machinery. In my experience, electric light and power plants in the Dominion are not designed at all, or if they have been, it has been by someone who has had machinery to sell, and who has therefore been more interested in selling a plant than in considering how it is going to operate afterwards. The consequence is that, I might really say, the majority (certainly the large majority of those I have seen), while having everything of good quality, good boilers, engines and shafting, good dynamos and lines, etc., regarded as electric lighting plants, and not merely as exhibitions of different kinds of machinery, are very ill adapted for economical operation under their local conditions.

Mr. Kammerer, in his very useful paper on "Day Loads," says truly that now-a-days a central station man when purchasing machinery asks, not "What is the price?" but "What is the efficiency?" This question itself indicates a very long stride forward; but let me suggest to central station men that the most vital question is not "How am I to get the most efficient machine?" but "How am I to get the most efficient plant?" The dynamo is not the only machine in a plant, and efficiency is a matter involving every apparatus from the boiler to the lamp. The highest "plant efficiency" is attained only when every piece of apparatus works harmoniously with the rest in attaining the object for which the plant was constructed, at the lowest possible cost. Regarded in this light, a dynamo may have a very high specific efficiency and yet be an important factor in producing a low "plant efficiency." This "plant efficiency" may be defined in various ways, such as (a) the proportion existing between the maximum capacity of the plant and the largest load it ever carries; or (b) the proportion between the actual kilowatt capacity for twenty-four hours and the largest kilowattage ever supplied during the same time; or (c) the proportion between the power equivalent of the combustible consumed under the boiler during one run and the electrical power actually delivered to the lines during the same time. None of these definitions include the plant efficiency of the lines and transformers, which, however, is also an important matter.

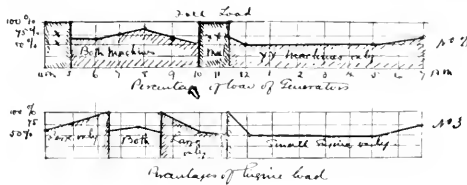
The first definition may seem to be rather unnecessary, in view of the probability that at least a man knows how much to buy, but a little consideration will show that a good many factors influence the decision of the proper-sized plant for certain conditions. For instance, the number and class of residences, stores, hotels, churches, etc., will be an approximate guide—taken in connection with the proposed rates—as to the total lighting that may ultimately be expected, and a very careful examination will very closely show what may be expected as the maximum load. Now, in both these estimates experience in the electric lighting business is necessary, and it is not business-like to buy machinery without having gone into them thoroughly. In one case that I have in mind, the ampere capacity of the plant was 750, and the heaviest momentary load at any time during the year was 620, and that lasted for just thirty minutes. It is evident that at no time was

the load more than 83 per cent. of the capacity, and anyone who has made out a load curve will see that the average load will be about half of this, or say 45 per cent. of capacity—and this for an average of about twelve hours during every twenty-four. In this case plant efficiency was low, and imposed a constant loss that the best operation in the world could not avoid, but that good preliminary engineering and design could and probably would have. It is not merely the unnecessary capacity of the dynamos alone; but the whole plant—engines, boilers, lines, etc.—were originally made too large. Inquiry elicited the facts that it was purchased and installed on the advice of the agents of the two manufacturing companies who supplied the engine and generators, etc. Definition (a) takes into consideration merely the actual total capacity of the plant, without reference to its division into units or to their arrangement. Definition (b) relates more specially to a plant where current is sold by meter; but (c) takes into account not only the total capacity, but also the manner in which this total is subdivided into units. This subdivision may seem a rather unimportant matter. To a person who operates an electric light and power plant as a business investment it is just as important as anything else; and the man who buys on efficiency rather than on price will admit the soundness of the claim, because it rests directly on machine efficiency. Illustrations from actual cases will have more point than purely theoretical discussion. Taking therefore the above case—the load line for the night that gave the highest maximum for the year was as in diagram. Maximum



620 amperes; minimum 160 amperes; and whereas the maximum was on for half an hour, the minimum was on for 5 hours. Is the subdivision into units of no importance in the above case? The minimum lasted one-third of the entire run, and was therefore an important consideration. The plant was a D.C. 3-wire one, divided into two 170 ampere machines, and two 200 ampere ones, with two long stroke engines of 120 and 65 h.p. at 80 lbs. steam, $\frac{1}{4}$ cut-off. The engines belted on to a shaft through clutch pulleys, and the shaft itself was divided in two by a clutch coupling. The engines were so arranged that the 65 h.p. drove that end of the shaft off which were belted the two 160 ampere dynamos, while the 120 h.p. belted on to the shaft driving the two 200 ampere machines; the clutch coupling of course permitted the running of the entire plant as one. The machines were over compounded 10%, giving 120 volts at full load. Now let us analyze the working of the station on the night of the given load line. From 4 p.m. to 5 p.m. there were about 400 amperes, just enough for the two 200 ampere machines, which we will designate XX, (the others being YY). The kilowattage therefore was 48,000—or 64 h.p. Allowing XX an efficiency of 90%, required nearly 71 h.p. to drive them, not taking two belt losses into account. This was closely the power of the 65 h.p. engine, but running this engine necessitated running the entire shaft, and the two empty YY dynamos. So that the 120 h.p. engine had to be used, and had to run on about 80 h.p. or 66% load—not very efficient. At 5 p.m. the load was above the capacity of the XX machines, so the YY's were thrown in as well, with a total combined capacity of 750 amperes. Thus from 5 p.m. to 10 p.m. the percentage of the load to the capacity of the machines varied gradually from 53% to 83%, and then back to 53% again. Looking at the engine plant during the same time; at 5 o'clock the 120 h.p. engine was running on about 65% load. When 550 amperes were reached, this engine was about properly loaded, counting dynamo efficiency at that point as 85%, and allowing for belts and shafting. At this point, therefore, the 65 h.p. engine had to be thrown in; so we now have engines to a capacity (economical) of 185 h.p. doing about 120 h.p., again 65%. From now—6.30 to 8.30 p.m.—the total load carried by the engine plant varies from 65% up to 73% and back to 65% again. From 8.30 (at which point the small engine is thrown out) to 10 p.m. the 120 h.p. engine runs on a percentage falling from about 100% down to 65%. Now returning to the generators—at 10 p.m. XX have a 100% load falling to about 75% at 11.15 p.m. There the YY machines are thrown in instead, with a load dropping from about 100% at 11.15 down to about 50% at midnight, which

percentage is kept for five hours, till 5 a.m., and then rises gradually to about 72%. During this period, from 10 p.m. down to about 11 p.m., the 120 h.p. engine must be run because the other would hardly have the power; it runs on a percentage of load falling from 65% down to about 58%. At about 11 p.m. the 65 h.p. will take care of the load and from now on to 7 a.m. it can run with percentage of load falling from about 100% down to 50% shortly after midnight, keeping it up till 5 a.m., and then gradually rising to about 75%. For clearness sake I give a diagram showing the percentage of full load at which the two parts of the plant operated, taken from the above figures; the percentage taken being that of the load at any moment relative to the full capacity of such machines as were actually used to give it.



A study of these diagrams will be interesting. Take No. 2. For just two hours during fifteen hours were any dynamos running at full load, and therefore at full efficiency. For about five hours the combined dynamo plant had an average of about 75% of full load, and therefore an efficiency of about 85%. For another five hours the VV dynamos had above 50% load, and an efficiency therefore of about 80%. Take diagram No. 3. During the whole fifteen hours' run, it will appear at a glance, that the steam plant was little more than half loaded. The efficiency of a steam plant is not very high under the most favorable circumstances; what it is under the conditions outlined I leave to each one to determine for himself. It may be thought that this is a special case selected as a horrible example. I beg to state that it is a very fair sample of the kind of engineering that results from the designing of power plants being left to those interested in the sale of machinery. I might give illustrations from a score of such plants in which the application of principles derived from the experience of electrical engineers would have had the most beneficial effects, if they had been applied to the preliminary engineering and design. There are some very obvious morals pointed by diagrams 2 and 3. About the most so is the advisability of designing a plant (both as regards steam and electrical machinery) with reference to the minimum load, quite as much as the maximum. Another is that the full load efficiency of machines is not of such great importance as the half load. Of course, in such a plant as the above, it is possible to improve matters by varying steam pressure in accordance with load, and allowing engines to work up to half stroke; but this will simply be an expedient, and what I particularly desire to point out is that preliminary engineering is of even more importance than good operation, because it depends on design whether the plant (not individual machines) will be efficient or not.

But, while preliminary engineering design has very great influence on subsequent economy of operation, the business policy outlined from the start has almost as great. This has to do with rates for lighting and power for the various different classes of consumers, rebates, lighting areas, method of collection, method of purchase of supplies, and many such points. It has always appeared to me that rates for incandescent lighting are capable of being greatly reduced. Instead of placing them at such figures as that even very small houses can take light, they are generally so high that only the best can afford it. I am quite convinced that in many plants a 20% cut in rates would be compensated for by a more than a counterbalancing rise in business; and in this I speak from experience derived from some plants that I am now managing. The rate question—and the other as to who is to do the wiring, the customer or the company—and some others can be altered from time to time; but the plant, once in, has got to stay. Mr. Armstrong says truly that "there is to-day no industry representing an equivalent money investment on a possibility of public service which is so generally managed by men who know nothing about it." The reason is not far to seek. The electric lighting industry is of comparatively recent date, and it is not such a very long time ago since first it began to be discovered that it was susceptible of being specialized. The growth and development of the business, and the competition of rival illuminants, has had the effect of evolving a new class of engineer—the central sta-

tion manager—and as time goes on and electric lighting business is better studied the new class of engineer will become a necessity, and investors will recognize his importance. The time is surely coming when central station owners will require some better qualification in their manager than the willingness to work for \$30 per month.

TRADE NOTES.

The Stevens Manufacturing Co., of London, Ont., have recently closed contracts for a 500 light plant for the town of Brussels, 500 light plant for Blyth, and 60 light are plant for Lucknow.

Sadler & Haworth, belting manufacturers, of Montreal and Toronto, have just furnished the Hull & Aylmer Electric Railroad with two double leather main driving belts one hundred and thirty feet long and thirty-six inches wide.

The Robb Engineering Co. are building two 300 horse power tandem compound engines, one for the Halifax Electric Tramway Co., and the other for the St. John Railway Co. This makes five of these engines sold to the Halifax Company.

The Kay Electric Co., of Hamilton, have completed the installation of an electric light and ventilation plant for the Ontario Agricultural College, Guelph. This firm has also recently furnished a 15 h.p. motor for the Shippe Wood Rim Co., of Toronto, a 250 light generator for W. Davidson, and one for Donald Fraser, of Fredericton, as well as several motors for Ottawa and other eastern points.

The new lumber mills and grounds of Messrs. D. & J. Ritchie & Co., at Newcastle, N. B., have been equipped with an electric light plant by John Starr, Son & Co., Ltd., Halifax. The installation consists of about 200 incandescent lamps of 16 and 32 c.p., and by it the output of the mills will be much increased. Messrs. Starr make a specialty of installing electric plants in lumber factories, and many of these in Nova Scotia and New Brunswick have been equipped by them.

The Boiler Inspection and Insurance Company, of Toronto, have made a new departure, namely, the inspection of electrical dynamos and motors in Montreal. Mr. R. A. Ross has been retained as consulting engineer, and skilled inspectors will make periodical inspections and keep the machinery in proper running order. By this means the risk of having the power supply stopped is greatly lessened, while the annual cost of maintenance is a fixed sum and can be better provided for. The company anticipates considerable business in this direction.

The Packard Electric Co., of St. Catharines, Ont., were compelled to operate their factory day and night during the month of June in order to supply the demands of their customers for lamps and transformers for the Jubilee celebration, while many orders remained unfilled. It is learned that Packard lamps were exclusively used in the decorations at the Parliament Buildings at Ottawa. The new type "L" transformer was the one principally used for the above purpose. One unique feature of this transformer is that it requires but one cross-arm upon the pole, and does not require any separate hangers, the arrangement for hanging being permanently attached to the transformer.

The Goldie & McCulloch Co., of Galt, Ont., advise us that they have lately made the following sales of machinery:—Wm. Doherty & Co., Clinton, 100 h.p. "Wheelock" engine; Methodist Book & Publishing House, Toronto, 85 h.p. "Wheelock" engine, with shafting, pulleys, friction clutches and couplings; The C. P. R. Co., for elevator at Owen Sound, 400 h.p. "Wheelock" engine with two steel boilers, condenser and all connections; Jacob Zurburg, New Hamburg, 60 h.p. "Ideal" engine and boiler; Toronto Electric Motor Co., Toronto, 35 h.p. "Ideal" engine; Gravenhurst Sanitarium, Gravenhurst, 40 h.p. "Ideal" engine; McGill University, Montreal, 100 h.p. "Ideal" engine; Geo. Munro, Thamesville, 60 h.p. steel boiler; Wingham Electric Light Co., Wingham, 68 h.p. "Ideal" engine, with 75 h.p. boiler and all connections; Smuggler Gold Mining & Milling Co., Fairview, B. C., 25 h.p. engine and 30 h.p. boiler; Johnson Electric Co., Toronto, 60 h.p. "Ideal" engine and boiler; New Hamburg Mfg. Co., New Hamburg, six locomotive fire box boilers; lot of milling machinery to Plattsville Milling Co., Plattsville; The R. Forbes Co., Hespeler, woollen mill machinery; S. Larue, Mount-ain, heading turner; Findlay Young, Killarney, Man., 85 h.p. "Wheelock" engine; Wm. Carey & Son, Windsor, N.S., lot of wood-working machinery; Wm. Mason & Son, Ottawa, wood-working machinery; Ferguson & Pattinson, Preston, six hydrants; The Tillson Co., Tillsonburg, flour mill machinery; Jas. A. Wilson, Cantley, Que., complete sawmill outfit, engine, boiler, sawmill machinery, and shafting; John Phillip, Grand Valley, 80 h.p. "Ideal" engine; Auld Bros., Shetland, a lot of mill machinery.

THE REVOLVING FIELD TYPE OF ALTERNATING CURRENT GENERATOR.

The development of the revolving field type of alternating current generator, and the standardization of a complete line, both for the monocyclic and three-phase systems, has of late occupied the attention of the engineering department of the General Electric Company, with successful results. The alternators are designed for the standard frequency of 60 cycles, and for pressures ranging between 500 and 5,000 volts.

The machines are built on the same lines as the Canadian General Electric type of induction motor. The stationary armature is built up of laminations stamped from specially selected and tested steel plates. Ample spaces are left for ventilation, and the coils are covered and protected by shields. The base of the armature is of smooth cast-iron, and the pedestals supporting the bearings are provided with spherical seats, which support the boxes and allow of perfect alignment.

The removal bearings are, of course, self-oiling, with the oilways so cut as to give an even flow of oil from the resting places of the rings in the shaft to the end of the bearings where the oil returns to the reservoir.

The revolving field is extremely simple of construction. It is merely an iron spider mounted on a shaft carrying a soft-steel ring serving as a yoke for the pole pieces, which are made up of laminated iron with polar projections. The field coils are removable, and in the larger sizes are wound with flat copper strips placed edgewise, to allow of free egress from the coils of any

heat. The armature can be moved along the base to facilitate access to fields and armature winding.

With a high efficiency, these alternators combine good inherent regulation, and can be, if desired, compounded for accurate automatic regulation. Such compounding in certain cases is not necessary to convenient operation, and may be omitted. When compounded a commutator is mounted on the shaft and rectifies current supplied from a series transformer in the main circuit. These compounding devices are not, however, included in the generator, properly so called. They come under the head of extras. The temperature of the armature and the field windings does not rise above 45 degrees centigrade above that of the surrounding atmosphere.

The new type of generator is not, of course, intended to displace the revolving armature type. The revolving field type has its own special field of usefulness. It is free from high-potential collector rings and commutators, the only collector rings being the two used to bring the exciting current to the revolving fields. The high-potential part of the alternator—the armature—being a stationary structure, can be wound and insulated for much higher pressures than is desirable for revolving armatures, and the current can be fed directly into the line without the intermediary of step-up transformers.

All the high-potential terminals are effectually insulated.

The revolving field alternators can be wound for the two-phase system when desired, and when so wound are so arranged that armature coils can be cut in or out to give independent regulation of the two phases.

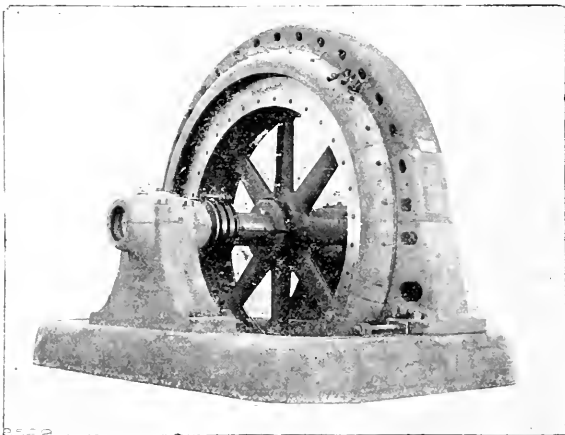
During the past year the Canadian General Electric Company has sold a number of machines of this type, some for belt drive, but principally for direct connection to water wheels. The illustration shows a 750-kilowatt, 40-pole, three-phase machine, running at 175 revolutions and delivering current at 4,400 volts. It is one of twelve which will be used on the Lachine Rapids installation.

Two more generators of the same type and size are now being constructed for the 30-mile transmission of the West Kootenay Power & Light Company. For very low potential work this type is especially well adapted, two of 150-kilowatt capacity each being in use at the Wilson Carbide Company's works at Merritt, Ont.

HOW MANCHESTER IS LIGHTED.

THE corporation of Manchester, England, owns and operates a large electric lighting system, which has

recently been fitted with the largest storage battery in the United Kingdom. It is not located in the central station where the current is generated, but about a mile distant, in a special sub-station. The current is distributed in Manchester by what is known as the five-wire system, a modification of the method followed by the Edison lighting companies in this country. The current as it is taken from the wires is of insufficient voltage to charge the



C. G. E. ALTERNATING GENERATOR, REVOLVING FIELD TYPE.

battery, and is accordingly transformed by a motor-generator to a current of 510 volts. The battery consists of 224 large cells, each containing 73 plates. The cells are made of heavy sheet lead, and are carried on iron and timber stands. The entire installation is divided into four distinct batteries of fifty-six cells each, coupled to the five-wire network of mains. Each of the batteries thus formed is further subdivided into two parts, one consisting of the battery proper of forty-four cells, and the other a regulating battery of twelve cells. All the cells are placed in five arched vaults under a street, three of the vaults containing the main batteries, the fourth being used for the regulating cells, and the fifth holding the motor-generator and switchboard. The normal maximum rate of discharge of the plant is 600 amperes from each of the four batteries, or a total current of 2,400 amperes delivered at 100 volts to the mains. The average rate of discharge is 300 amperes, which is also the normal charging rate. The entire night load after midnight is taken by the cells, thus allowing a large reduction in the number of men employed from 10 o'clock in the evening until 6 on the following morning, while on Sundays relief is also given to the men working during the day, the battery taking the day-load up to 4 o'clock in the afternoon in addition to the load of the previous night.

ELECTRICAL DEVELOPMENT IN AUSTRALIA.

Mr. J. S. Larke, of Sydney, N. S. W., writing to the Dominion government under date of April 10th, 1897, gives the following particulars of electrical matters in Australia:

ELECTRICAL WORK.

The railway construction branch of the Department of Public Works, of the government of this colony, will shortly complete plans and specifications for an electric street railway for this city.

The city of Sydney last year secured powers to effect a loan of a million and a half dollars to erect plant for lighting the city by electricity. Pending the conclusion of negotiations with the government respecting a common supply for lighting and street railways, nothing has been done in the matter. It is possible that within a short time tenders will be asked for both of these important works, and if Canadian electrical companies desire to compete it is advisable that they should watch for the advertisements. It is probable that the adventsirements will appear in London and this city at the same time, so that the London advertisements would be first seen in Canada. There will be, undoubtedly, an extension of electrical works in Australia, at a much more rapid rate than has hitherto been the case. Melbourne has a very effective cable system, but with that and another exception all the cities of the colonies are served by horse or steam lines or busses, when an electrical system would be preferable.

At the request of a Canadian company I have made inquiries into the consumption of carbons in these colonies, with the following result:—

CARBONS.

The total consumption of carbons in Australasia is estimated to be about three millions per annum. In New Zealand and Victoria electric lighting has made greater progress than in this colony.

No approximation of the sizes used can be given, but in the Railway Department of New South Wales the following are the sizes, number of each sort, and prices paid in 1896:—

					s.	d.
Brookie-Pell,	9 in.,	13 mm.,	solid ;	12,000 per hundred...	3	10
"	15	15	cored ;	5,000 "	10	6
"	15	13	"	8,000 "	7	0
"	12	18	"	10,000 "	10	0
"	9	18	"	2,000 per hundred ft.	7	9
"	12	15	solid ;	4,000 "	8	0
"	9	15	"	5,000 "	6	6
"	15	18	cored ;	2,000 "	12	6

Brush, 12 in., 11 mm., solid, coppered, 12,000 per thousand feet, £3 7s 6d.

The thickness is given as in the case of all carbons here in millimetres. The Post Office Department uses 12 x 12 and 12 x 18, 13 x 9 and 13 x 15. As a rule the Post Office Department and electric light companies paid slightly higher rates than those paid by the Railway Department.

The following letter from the Department of Customs, Melbourne, gives the information respecting Victoria:—

"In reply to your enquiry of the 16th instant, relative to electric carbons, I beg to state that the quantity of goods imported is not available, the item being included under the heading of 'Electrical Goods.' Those used by the government of Victoria are all tendered for in the colony.

The Railway Department uses 11 millimetres solid and cored carbons, for which they pay under the present

contract, £2 per 1,000. Brush carbons the same size are also bought for £2 per 1,000, and of ten ampere currents.

The Postal Department uses the following under present contract:—

12 mm. carbons, cored, 12", 8,000 at £2 14 0 per 1,000.

12 mm. carbons, plain, 7", 2,333 at £2 14 0 per 1,000.

13 mm. carbons, cored, 15", 2,500 at £2 18 0 per 1,000.

19 mm. carbons, cored, 13", 1,083 at £2 18 0 per 1,000.

11 mm. carbons, plain, 12", 2,000 at £2 10 0 per 1,000.

9 mm. carbons, plain, 9", 750 at £1 10 0 per 1,000.

Those supplied at the Parliament House are the "Conradty," at £4 4s 0d per 1,000; size, 7 10 in. x 12 in. moulded.

The city corporation uses Fooke's and Hartmann's under the present contract; size, 7 16 in. x 12 in. (11 mm.), the yearly estimate being 600,000 at £1 12s 10d per 1,000.

The estimated number used annually by the various government departments in Victoria and the city council is 750,000.

I think the demand for carbons will increase, but it is not doing so rapidly just now.

The carbons used here are mainly imported from Austria. United States makers have sent some here, but they have made no headway. The opinion seems to be that they are much higher in price and inferior in quality to the Austrian.

ANNUAL MEETING OF THE ROYAL ELECTRIC COMPANY.

THE Royal Electric Company held their annual meeting in Montreal on July 8th, at which the following directors were re-elected: Hon. J. R. Thibaudeau, president; D. Morrice, vice-president; F. L. Beique, A. Brunet, Allan Macdonnell, F. S. Holt, Edwin Hanson, J. A. L. Strathy, and Robert Cowans.

The annual report showed the revenue for the year to be \$900,348.10, and the expenditure for labor, materials, operation, maintenance and general expenses, \$636,467.99, leaving a gross profit of \$243,880.11. Deducting interest and fixed charges of \$43,245.83, left a net profit from business of \$200,634.24. From this net profit four quarterly dividends of 2 per cent. each were declared.

Additions and improvements to the factory and its equipment to the value of \$58,210.23 were made during the year, and on lighting stations, lines and installations and general construction the sum of \$90,880.30 had been expended for a like purpose. The total value of the additional equipment was thus \$158,000.53.

In connection with the placing of new generators and switchboards in the incandescent lighting station, a work completed in November last, it was noted that the saving in fuel resulting therefrom amounted to 4,015 tons.

During the Queen's Jubilee nearly 20,000 incandescent lights and about 200 arc lights were provided by the company in addition to the requirements of regular customers. During the month of April last arrangements were completed for placing the balance of the authorized capital stock of the company, namely, \$250,000 par value, in London, England.

DIRECT CURRENT MULTIPOLAR DYNAMO.

The accompanying illustrations represent a new type of direct current multipolar dynamo, manufactured by the Electrical Construction Company, of London, Limited, and specially adapted for isolated lighting plants. Among other features the manufacturers claim for this machine the following points of merit:

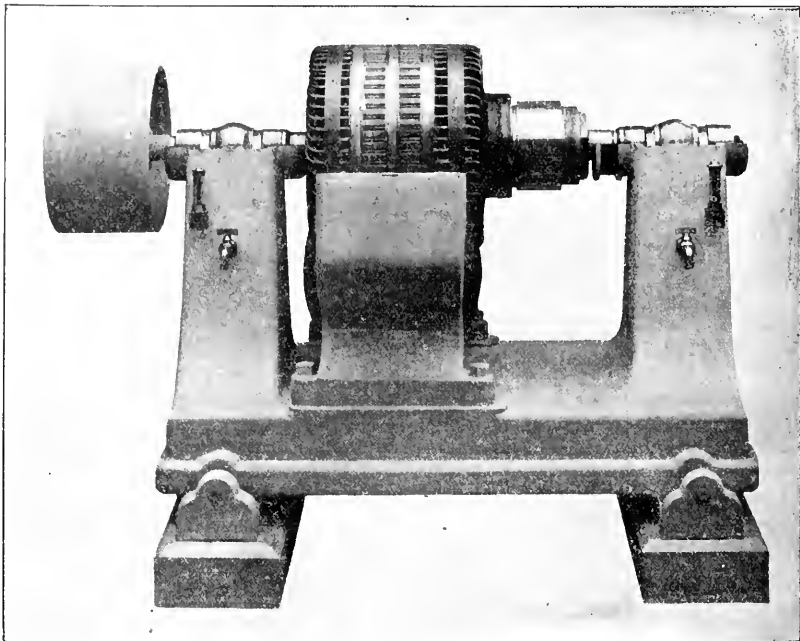
A minimum number of parts are employed in its construction, and all the mechanical details are so perfect in design that absolute interchangeability of parts is obtained.

The field magnets are made from a special quality of cast steel, and the metal is so placed, and so used, that there is no choking of lines at any point of the magnetic circuit; nor has any attempt been made to work the magnetic frame to its full limit of saturation.

The shunt and series coils are wound up separately,

and are secured to the pole pieces by suitable clamps.

The slotted type of armature is used on this machine. The coils are so designed and placed in the armature



OPEN VIEW—DIRECT-CURRENT MULTIPOLAR DYNAMO.

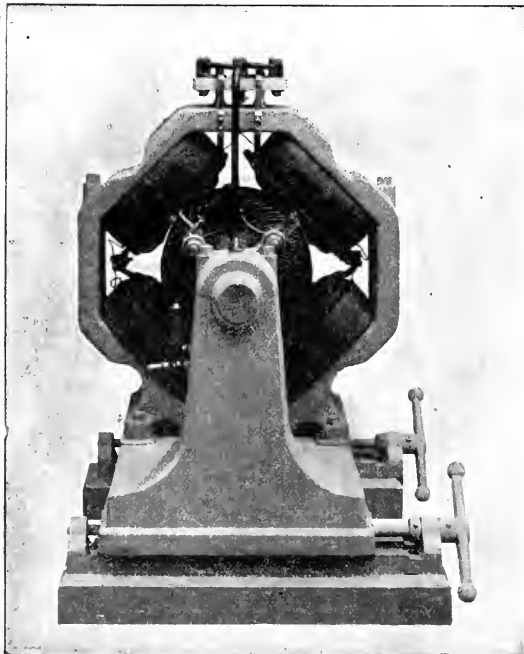
that they are interchangeable at every point. They are of equal length and ample conducting capacity.

The commutator is very large and designed for the use of carbon brushes. The carbon brushes are so constructed that the contact between the carbon and the machine terminals is through a flexible conductor strip clamped securely to the carbon brush. This design absolutely prevents arcing between the brush and its holder.

The bed-plate is made in one piece, and is very stiff and strong; it supports the barrel bearings of the armature, which are of the self-aligning and self-oiling type.

The apparatus is made in the following sizes, viz., 4, 7½, 15, 20, 30, 40 and 60 k.w.

The Electrical Construction Company also manufacture a complete line of direct-current stationary motors, in sizes from one to one hundred horse power, and have a fully equipped repair shop. Their office is at 90 York street, London, Ont.



NEW TYPE DIRECT-CURRENT MULTIPOLAR DYNAMO.

The city council of Grand Forks, B. C., will borrow money with which to purchase an electric light plant.

The town of Owen Sound, Ont., have accepted an offer made by the Owen Sound Electric Light Company to supply 30 lights at \$75.00 per year, running under the moonlight schedule.

The motor of the new swing bridge at Hamilton Beach burned out recently, and the bridge had to be swung by hand. James Eustace, the young man who was operating the bridge when the motor burned out, had a narrow escape, his watch chain being fused and his face singed. The accident was caused in a peculiar manner. When Eustace was in the power house his watch chain fell across a wire, making a short armature and sending up a blaze several feet into the air.

WESTERN ONTARIO LIGHTING PLANTS.

BELOW will be found brief descriptions of several electric lighting plants in Western Ontario, from the perusal of which some points of instruction may be gathered.

DRESDEN ELECTRIC LIGHT PLANT.

The old plant in this town was totally destroyed by fire in August, 1896, and the present plant was installed in September following. It is located in a detached brick one-story building, 20 x 40 feet, and is an alternating system, a Thomson-Houston generator, with speed of 1,500 revolutions, furnishing current for nine arc lights and about 300 incandescent lamps. The switch-board is fitted with Canadian General instruments of latest design. One of the special features of this plant is said to be the very satisfactory service to patrons.

The belt is run direct from engine to dynamo, no counter-shafting being used. The steam power is supplied by a 95 h. p. boiler and an 85 h. p. Leonard Ball automatic cut-off engine. The plant is under the efficient management of Mr. W. F. Jameson, and is owned by Mr. J. E. Gordon, the proprietor of the Dresden stove mills.

ST. MARY'S ELECTRIC LIGHT PLANT.

This plant, owned and operated by Mr. L. H. Reesor, is furnishing a very satisfactory service to the citizens of St. Marys. The company have installed now about 1,000 incandescent lights of 16 candle power. Their power house is conveniently situated in a central locality and is equipped with a National 500 light machine and two 50 Ball arc generators, with National switch-board and instruments.

In connection with the plant there is a well equipped stock room, provided with shelving and compartments, and well stocked with all the necessary parts required for repairs. Power is supplied by two 50 h. p. turbines, supplemented by a steam engine to maintain an equal running power. Mr. W. J. Stevenson is the electrician in charge.

FOREST ELECTRIC LIGHT COMPANY.

The electric light plant at Forest is owned and operated by Messrs. Hamilton & Proutt, the well known planing mill proprietors. It is located in a commodious brick addition to their mill, and is equipped with 800 light Royal dynamo for their incandescent light system, and a 50 arc light Thompson generator for arc street lamps. A special feature of this plant is a handsome marble switch board, 6 x 4 ft., fitted with General Electric instruments. The mill engine supplies the necessary power. This company are at present furnishing about 250 incandescent lamps and 11 arc lights.

PETROLIA ELECTRIC LIGHT, HEAT AND POWER COMPANY.

The officers of the above company are as follows: G. Y. Ashworth, president; Walter MacDonald, vice-president and secretary; W. H. Ashworth, manager. The plant was installed and commenced service on January 15th, 1895. The power house is a frame structure 35 x 70 ft., with flat roof. The driving plant consists of two boilers, one of 100 h.p. and the other of 150 h.p. capacity, and a 100 h.p. Wheelock condensing engine, with thirteen foot fly-wheel. The generators are a Thomson-Houston 1,000 light alternator, a 50 light arc, and a 350 light Royal, for use when overloaded, the switchboard instruments being from the Canadian General Electric Co. Their service at first consisted of 30 arc lights and about 200 incandescent lamps, but at present they are furnishing 39 arc lights, with a candle power of 1,200, and 1,700 incandescent lamps.

Electric power from this plant is used in oil pumping, this being the first instance in the world where electricity has been used for that purpose. During last July the company put in a 15 k.w. General Electric generator

of 500 volts, to furnish power for a motor at a batch of sixteen wells, and which has given every satisfaction. The increasing number of wells being bored will lead to its more general adoption, as its adaptability and cheapness over steam power has now been proven.

Owing to scarcity of water this plant has a very novel condensing system, making use of four tanks, fifty feet in depth by twelve feet in diameter, connected by syphon arrangement, the pump for heater being led from nearest tank by three inch pipe, and the water from condenser being carried by pipe and open trough to farthest tank.

This company are oil producers as well, having four wells in their yard which they operate.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO NO. 1.

The regular meeting of Toronto No. 1 was held on July 7th in Engineer's Hall, 61 Victoria street. After the regular business had been dealt with, Bro. E. J. Philip installed the following officers for the ensuing year: President, G. C. Mooring; vice-president, T. Eversfield; recording secretary, J. W. Marr; financial secretary, J. Bain; conductor, G. Thompson; door-keeper, T. Cadwell; treasurer, S. Thompson.

MONTREAL NO. 1.

A largely attended meeting of Montreal No. 1 was held in their hall on Craig street on June 17th, the occasion being the twelfth annual meeting for the election of officers. The following were elected: President, Wm. Smyth; 1st vice-president, Wm. Bowden; 2nd vice-president, P. McNaughton; recording secretary, J. O'Rourke; financial secretary, Harry Nuttall; corresponding secretary, Thos. Ryan; treasurer, G. Jones; librarian, Wm. Ware; conductor, J. Morrison; door-keeper, James Wilson; trustees, J. J. York, O. G. Granberg, George Hunt. A large amount of business was transacted. Several new by-laws were passed and others altered, tending towards the better government of the association.

HAMILTON NO. 2.

At the regular meeting of Hamilton No. 2, held a fortnight ago, the following officers were installed by the past-president of the executive, Bro. Blackgrove, of Toronto No. 1: President, W. Norris; vice-president, G. Mackie; recording secretary, J. Ironside; financial secretary, J. Carroll; treasurer, W. Nash; conductor, J. Johnston; door-keeper, T. Carter. The retiring financial secretary, E. Nash, was presented with a handsome secretary by past-president R. Mackie, on behalf of the association.

LONDON NO. 5.

The election of officers took place at the last meeting of the above association, with the following result: D. G. Campbell, president; B. Bright, vice-president; W. Meaden, treasurer; W. Blythe, secretary; W. Burkholder, conductor; R. Evans, doorkeeper. The officers were installed by the retiring president, Bro. G. Risler. The subject for discussion was "The Gain in Power Due to the Expansion of Steam in a Cylinder," which was ably handled and illustrated. A number of engineering questions are being prepared for competition by the members, for the best solution of which a prize will be given.

KINGSTON NO. 10.

Kingston branch installed new officers at their last meeting, past-president S. Donnelly being master of ceremonies. The officers now are: F. Simmons, president, re-elected; C. Asselstine, vice-president; J. L. Orr, secretary; C. Selby, treasurer; W. Woodrow, conductor; R. Burgess, doorkeeper; S. Donnelly and C. Blomley, trustees. F. Simmons and C. Selby were appointed delegates to the annual convention to be held in Brockville next month.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his study without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURES—Definition and explanation and practical demonstrations of.

CIRCULAR AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Type)—Principles of, with practical demonstrations.

PIPER CONSTRUCTION—Nails, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular. Wm. Thompson.

[ARTICLE III.]

PRACTICAL MEASUREMENTS.

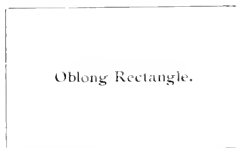
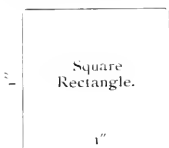
THE practical measurements herein referred to and treated as being of especial benefit to engineers, are distinguished as measures, of surface, of volume and of capacity.

MEASURES OF SURFACE OR SQUARE MEASURE.

SURFACE is that which bears reference to length and breadth only, depth or thickness not being considered.

The **AREA** of a surface is the number of square feet, inches or yards, etc., that such a surface contains.

A **RECTANGLE** is a surface which has four right angles.



Rule: To find the area of a rectangle or square, multiply the given breadth by the given length, and the product will be the area.

Rule: To find the required length of either side of a rectangle or square, divide the given area by the given length of known side.

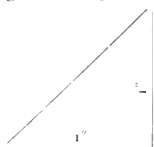
Example: Find the length of a surface whose area is 95 sq. in. and breadth 5 in.

$$95 \div 5 = 19 \text{ in.} = \text{length required.}$$

IRREGULAR OR TRIANGULAR MEASUREMENTS.

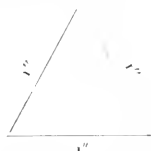
A **triangle** is a surface having three sides and three angles.

An **Isosceles triangle** is a triangle having two equal sides.



ISOCELES TRIANGLE.

An **Equilateral triangle** is a triangle having three equal sides.



EQUILATERAL TRIANGLE.

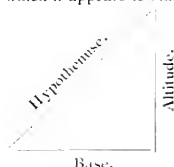
A **Scalene triangle** is a triangle which has no two sides equal to each other.



SCALED TRIANGLE.

The base of a triangle is the line which intersects the other two lines at the point greatest distant from the vertex.

The lines representing the base and altitude are perpendicular to each other, and if a triangle be placed vertically, the base will be the side on which it appears to stand.



Rule: To find the area of a triangle, multiply the base by one-half the altitude, and the product will be the area.

Rule to find either the altitude or base of a triangle, area, and one side being known: Divide the area by one-half the given dimension, and quotient will be required dimension of other side.

Example: Find the required length of the base of a Scalene triangle whose altitude is 6 inches and area equals 36 inches.

$$36 \div \text{by one-half altitude} = 36 \div 3 = 12", \text{ required length of base.}$$

CIRCULAR MEASUREMENT.

A **circle**, as geometrically defined, is a plain figure bounded by a curved line, all parts of which are equally distant from the centre.

The **circumference** of a circle is the curve which bounds it.

The **diameter** of a circle is a straight line that passes through its centre.

The **radius** of a circle is a straight line that joins the centre to a point in the circumference.

[Note: Referring to this, it follows that the radius is one-half of the diameter.]

Rule: To find the circumference of a circle, the diameter being given, multiply the given diameter by 3.1416, and the product will be the circumference.

Rule: To find the diameter of a circle, the circumference being given, multiply the given circumference by the decimal .3183, and the product will be the diameter.

Rules: To find the area of a circle, the circumference, radius or diameter being known,

Multiply the circumference by one-fourth the diameter, and the product will be the area;

Or, multiply the square of the radius by 3.1416, and the product will be the area;

Or, multiply the square of the diameter by .7854, and the product will be the area.

Example: Find the area of a circular bolt 3.1416 inches in circumference.

$$\text{Circumference} \times .3183 \text{ equals dia.}$$

$$3.1416 \times .3183 = 1" \text{ diameter,}$$

$$1 \div 4 = .25 = \text{one-fourth dia.}$$

$$3.1416 \times .25 = .7854 \text{ sq. in. area.}$$

Example: Find the area of a circle whose radius is one-half inch.

$$\text{Radius squared} \times \text{by } 3.1416 =$$

$$.5 \times .5 = .25 \times 3.1416 = .7854 \text{ sq. in. area.}$$

Example: Find the area of a circle whose diameter is 1 inch.

$$\text{Diameter squared} \times .7854 =$$

$$1 \times 1 = 1 \times .7854 = .7854 \text{ sq. in. area.}$$

A review of these examples will prove clearly to the student why constant .7854 is used in formula when it is necessary to find area of any circle, and needs no further comment.

MEASURES OF VOLUME OF SOLID BODIES OR CUBICAL MEASUREMENTS.

Cubical measurement includes length, breadth and thickness being taken into consideration.

The process of finding the cubical contents of a solid body is similar to finding the area; in fact, area multiplied by thickness will give cubical contents.

MEASURES OF CAPACITY AND CUBICAL CONTENTS OF SQUARE AND CYLINDRICAL BODIES.

Measures of capacity embrace measurements of barrels, tanks, bins, boxes, cylinders, etc., etc.

The liquid gallon of the United States contains 231 cubic inches.

The Imperial or British gallon contains 277.274 cubic inches.

A cubic foot of water contains approximately 6.25 Imperial gallons and weighs 62.5 pounds avoirdupois at 62° F. under atmospheric pressure.

Rule: To find capacity of a square tank, dimensions of which are known, multiply length by breadth and product by depth, and result will be cubical contents.

Example: Find the number of Imperial gallons of water a rectangular tank will contain, inside measurement of tank being: length 20 feet, width 15 feet, depth 3 feet 6 inches.

Formula: $\text{Length} \times \text{width} \times \text{depth} \times 1728 = \text{Imperial gallons.}$

$$\begin{array}{r}
 277.27 \\
 20' = \text{length.} \\
 15' = \text{width.} \\
 100 \\
 20 \\
 \hline
 300 \\
 3.5 = \text{depth.} \\
 1500 \\
 900 \\
 \hline
 1050.0 = \text{cubical contents in cu. feet.} \\
 1728 = \text{cubic inches in one cu. foot.} \\
 8400 \\
 2100 \\
 \hline
 7350 \\
 1050 \\
 \hline
 1,814,400 = \text{cubic inches}
 \end{array}$$

$$1,814,400 \div 277.27 = 6543.8 \text{ Imp. gallons,}$$

or, when absolute correctness is not required, short method formula as follows may be adopted.

Length in feet \times width in feet \times depth in feet $\times 6.25 = \text{Imp. gallons.}$

$$20' \times 15' \times 3' 6" = 1050 \times 6.25 = 6562.5 \text{ Imp. gals.}$$

Example (2): How many gallons (U. S.) of oil will cylindrical oil tank hold whose internal dimensions are: Depth 4 feet 6 inches, diameter 3 feet.

Formula:

$$\text{Diameter squared} \times .7854 \times \text{depth} \times 1728 = \text{U. S. gallons.}$$

$$\begin{array}{r}
 3' \times 3' = 9' \times .7854 = 7.0686 = \text{area in sq. feet} - 7.0686 \\
 \hline
 4.5 \text{ depth.} \\
 31.80 \text{ cap. in cu. ft.} \\
 1728 \\
 \hline
 54950.4 \text{ cap. in. cu. in.} \\
 54950.4 \div 231 = 237.9 \text{ gallons oil.}
 \end{array}$$

Example (3): It is required to fit a tank into a recess 6 ft. wide and 14 ft. 6 in. long. Tank to be made of 3 in. plank and contain 5000 Imperial gallons of water. What height should tank be so as to allow sides to project 6 in. above the water line?

First find exact internal measurement of tank, then exact quantity of water contained in each inch of depth; divide required quantity of water by this product, and add 6. Result will be required height.

Dimensions of recess are given as 6' \times 14' 6". Since, however, tank is to be constructed of 3 in. plank, twice this thickness must be deducted to get internal measurement of tank,

$$\begin{array}{l}
 \therefore 6' - 6" = 5' 6" \text{ internal width of tank.} \\
 14' 6" - 6" = 14' \text{ internal length of tank.} \\
 14' \times 5' 6" = 11.688 \text{ sq. inches.} \\
 11.688 \div 277.27 = 39.99 \text{ Imp. gals. per inch.} \\
 5000 \div 39.99 = 125 \text{ inches to water line.} \\
 (125 \div 6) \div 12 = 10' 11" \text{ height of tank.}
 \end{array}$$

Example (4): A tank 1 in. deep, 2 ft. long and 4 ft. wide, is found to contain 70 Imperial gallons of oil. How far from the top is the oil, and what is capacity of tank when full?

Since one gallon of oil is equal to .16 cu. ft., we can here materially shorten our calculation by working decimally.

First find how many cubic feet 70 gallons are equal to by multiplying by .16.

$$70 \times .16 = 11.2 \text{ cu. feet,}$$

and as the tank is 2 feet by 4 feet, its base will equal 8 sq. ft.

Then divide 11.2 cu. feet by 8 sq. feet to get height of oil.

$$11.2 \div 8 = 1.4 \text{ feet height of oil.}$$

The tank is given as being 1.75 feet high,

$$\text{and the oil is } 1.40 \text{ " " "}$$

then oil is 0.35 feet from the top.

0.35 feet = 4.2 inches distance from top of tank to oil.

To find capacity of tank when full, we first find cubical contents of tank in feet and then divide by .16.

$$1.75 \times 2 \times 4 = 14 \text{ ft., cubical contents of tank.}$$

$$14 \text{ feet} \div .16 = 87.5 \text{ gallons of oil in tank when full.}$$

Example (5): If one cubic foot of coal weighs 84 pounds, what weight of coal will a car contain 30 feet long, 6 feet wide and 5 feet deep?

First find cubical contents of car in feet, then multiply by weight per cu. ft. Result will be total weight of coal.

$$30 \text{ ft.} \times 6 \text{ ft.} \times 5 \text{ ft.} = 900 \text{ cu. feet.}$$

$$900 \times 84 = 75600 \text{ pounds of coal.}$$

Example (6): How many cubic feet of steam will a cylinder contain, 18 in. \times 36 in., with 5 per cent. clearance, and how many cubic feet will be used per hour if engine runs 75 revolutions per minute.

First find cubical contents of cylinder, including clearance, then multiply by strokes per minute, and this product by 60. Result will be number of cubic feet of steam consumed per hour.

$$18 \text{ in.} \times 18 \text{ in.} \times .7854 = 254.47 \text{ sq. in., area of cylinder.}$$

254.47 \times 36 in. = 9160.92 cubical contents of cylinder without clearance.

9160.92 \div .95 \times 100 = 9653.6 cu. in. = contents of cylinder, clearance included.

$$9653.6 \div 1728 = 5.58 \text{ cu. feet.}$$

$$5.58 \times 75 \times 2 = 837 \text{ cu. ft. steam per minute.}$$

$$837 \times 60 = 50,220 \text{ cu. ft. of steam used per hour.}$$

PRACTICAL RULES WORTH REMEMBERING.

The diameter of a circle \times by 3.1416 = the circumference.

The circumference of a circle \div by 3.1416 = diameter.

The radius of a circle \times by 6.283185 = circumference.

The circumference of a circle \div 6.283185 = radius.

The square of the radius of a circle \times 3.1416 = the area.

The square of the diameter of a circle \times .7854 = the area.

The square of the circumference of a circle \times .07958 = the area.

The circumference of a circle \times .0150155 = the radius.

The square root of the area of a circle \times 1.12838 = the diameter.

A semi-circle is $\frac{1}{2}$ of a circle, or 180 degrees.

A quadrant is $\frac{1}{4}$ of a circle, or 90 degrees.

A sextant is $\frac{1}{6}$ of a circle, or 60 degrees.

Next issue will contain examples of square and cube root, and definitions of signs and symbols for algebraical formulae.

SPARKS.

The running of electric cars on Sunday in Kingston is being protested by the Lord's Day Alliance.

The Nelson Electric Light Company has decided to increase the capacity of its plant, at a cost of \$10,000.

A by-law will be submitted to the ratepayers of Vernon, B. C., to raise \$12,000 for the purchase of an electric light plant.

A perfected horseless carriage, it is announced, will soon be turned out of the works of the General Electric Company, in Lynn, Mass.

The Osler syndicate is still negotiating to secure control of the Hamilton and Dundas and the Hamilton street railways. Several offers have been made, but as yet no agreement has been reached.

A proposition has been made to amalgamate the Brantford Street Railway and the Hamilton, Chedoke and Ancaster Electric Railway for the purpose of making direct connection with Paris, by way of Brantford.

The vast march of progress within one generation is strikingly illustrated by the death, only a short time ago, of Joseph Bell, the engineer who drove Stephenson's first locomotive. After escaping numerous perils on the road, he met his death by falling through an open hatch on the street. Another illustration is Sir Isaac Holden, who was a member of last parliament, and is still an active old gentleman, who invented the lucifer match.

SPARKS.

The Association of Telephone Superintendents met at Niagara Falls, N. Y., on June 16th.

The town of Dartmouth, N. S., have now under consideration offers for electric lighting.

The Toronto Electrical Works Company has been incorporated at Toronto, with a capital stock of \$30,000.

A money by-law, to increase the electric light plant, was recently defeated by the ratepayers of Picton, Ont.

Mr. W. R. Burke, manager of the G. N. W. Telegraph office at Ingersoll, Ont., was recently smothered by gas.

It is expected that telephone communication between Halifax and St. John will be established within a short time.

Walter Stewart's saw mill at Lucknow, Ont., in which was located the electric light plant, was recently destroyed by fire.

Superintendent H. W. Kent, manager of the Nelson & Vernon Telephone Co., has completed a line from Rossland to Spokane.

The Bell Telephone Company will supply the town of Carleton Place, Ont., with an electric fire alarm system, at a cost of \$1,000.

A by-law to grant \$5,000 towards an electric railway from Perth to Lanark was defeated by the ratepayers of the former town recently.

The estate of the defunct Citizens' Telephone Exchange at Waterloo, Que., has been sold to the Pare & Pare Company, of Granby.

E. J. Cuisack, of Havelock, N.B., has invented a compressed air motor for which he has secured patents in Great Britain, Canada and the United States.

The American Street Railway Association, which held its annual meeting in Montreal two years ago, will assemble in convention at Niagara Falls, N.Y., on October 19th next.

It is with regret we learn that the well-known firm of Patterson & Corbin, car manufacturers, St. Catharines, Ont., have not been prosperous of late, and that it is probable their works will be closed down.

The Taylor Hydraulic Air Compressor Company, of Montreal, elected the following directors for the ensuing year: Messrs. S. Carsley, Joseph R. Fair, George Durnford, W. L. Campbell and R. L. Murchison.

The receipts of the Toronto Street Railway Company for the month of June show a gain over the same month last year of about \$7,000, the respective figures being, \$92,015.16 and \$85,195.13. In the former figure is included the receipts on Sundays.

The By-Town and Aylmer Turnpike Union Road Company have entered an action against the Hull Electric Railway Company, claiming \$20,000 damages, and to compel the latter company to remove their line from Aylmer road to Suspension Bridge.

The C. P. R. Telegraph Company recently made a record in connection with the Queen's message to Ottawa. The message from Buckingham Palace to the Earl of Aberdeen, Rideau Hall, was sent direct by the Commercial Cable Company to Canso and from there over the C. P. R. line to Ottawa. The period of transmission, including return message, was seven minutes.

The Canadian Power Company have commenced work on its proposed power canal at Niagara Falls, Ont. This canal will be about 200 feet wide at the bottom and about 4,000 feet long, and will extend from the Chippewa Creek to the head of the Dufferin Islands. Mr. R. Paine, of Niagara Falls, who is one of the promoters, states that it is the intention to develop 40,000 h.p. at once.

A syndicate, composed of Messrs. T. G. Blackstock, J. W. Langmuir, W. Willson, W. B. Rankine, W. C. Ely, Alexander Fraser and J. M. Bostwick, have laid before the Ontario Premier a project to construct another bridge across the Niagara river, near Lewiston, and an electric belt line railway passing over the two bridges and the intervening stretches along both sides of the river.

The annual meeting of the shareholders of the Dominion Telegraph Company was held in Toronto recently, at which the board of directors were re-elected, viz., Thomas Swinyard, president; Hon. Sir Frank Smith, vice-president; Gen. Thomas T. Eckert, A. G. Ramsay, Henry Pellatt, Hector Mackenzie, Thos. F. Clarke, Thomas R. Wood, Charles A. Tinker, and F. Roper, secretary and treasurer.

Alderman Woods has given notice in the Toronto city council that he will move that it be an instruction to the city engi-

neer, when considering the cost of establishing an electric light plant at the new municipal buildings, to also consider the advisability of installing a plant of sufficient capacity to provide for the lighting of all municipal buildings, public streets and parks, as well as the supply of power to manufacturers.

After careful investigation into the circumstances of the recent Point Ellice bridge disaster at Victoria, B.C., the jury has rendered a verdict holding the directors of the Consolidated Railway Company responsible for the lives lost. The city council was arraigned as guilty of contributory negligence and the officials of the corporation were absolved of personal responsibility. It was found that the accident would not have occurred but for the improper crowding of the cars, and also that the bridge was not constructed according to the original specifications.

The Minister of Public Works for the Dominion has made known the intention of the Government to install a complete electric light plant at the Parliament Buildings at Ottawa, at a cost of \$75,000. At present the buildings are lighted by both gas and electricity, the former costing from \$18,000 to \$22,000 per year. It is proposed to enlarge the present station under the hill sufficient to develop power to light the buildings by electricity throughout and drive a system of electric pumps to afford adequate protection against fire. Tenders for the plant will be invited.

An exchange tells of a curious effect of an electrical storm in Chicago on June 16th. The iron structure of the swing bridge over the river at Harrison street was charged. This bridge is electrically connected with the return circuit of an electric railway line, and this connection seemed to "short-circuit" the electricity of the air. George Browne, who was driving near by at the time, urged his horse out upon the bridge in spite of the blue flames that were playing along the iron rods. The animal was hardly upon the structure before the electricity leaped up through the iron calks of its shoes and it went down in a heap, stone dead. Brown leaped from his seat and ran away, and the few pedestrians on the bridge at that time made all haste to get away. A fire and police call brought policemen and a chemical engine to the spot. The police had hard work to keep the crowd back. The draw was finally swung open and the circuit broken. During the storm one young man was struck by lightning and instantly killed. Several others were injured, and there was considerable damage to property.

NOTES.

Vertical belts should be drawn tight enough so that the belt will cling to the lower pulley. Laced belts often break where connected, on account of friction caused by slipping and movement between the lace and belt, which wears away the lace.

One pound of carbon, in burning perfectly, forms $2\frac{1}{2}$ pounds of carbonic oxide, and develops 4344 heat units. The carbonic oxide, in burning perfectly, develops 10,210 heat units in forming carbonic acid, making $10210 + 4344 = 14554$ heat units, or the same amount of heat units that would be obtained by the complete combustion of one pound of carbon.

TO PREVENT BREAKAGE OF GLASS GAUGES.—Breakage of glass water-gauges fitted to steam boilers may be prevented in many instances by fusing the edges at the ends, and so finishing them off smoothly and evenly instead of breaking and grinding them. Guards made of toughened glass are also recommended as means of protection to persons standing by in case of gauge-bursting.

Herren L. Holborn and W. Wien have compiled a table, reproduced in the Scientific American, showing the heat-conducting power of the different values. The average value of the different kinds of iron and steel is given. The factor, R, indicates that through a plate of one centimetre thickness, at a difference of temperature of one degree for one square centimetre each, a quantity of heat passes which will increase the temperature of R gramme of water by one degree: Copper, R equals 0.918; iron, R equals 0.156; steel, R equals 0.062 to 0.111; zinc, R equals 0.292; tin, R equals 0.150; lead, R equals 0.079.

We have received, by the kindness of Messrs. John Starr, Son Co., a copy of an illustrated souvenir of the Queen's Diamond Jubilee, entitled "Halifax of To-Day," and published by W. H. Howard. It contains numerous half-tone illustrations of buildings and scenes in Halifax, together with a brief description of same.

ELECTRIC RAILWAY DEPARTMENT.

NEW METHOD OF STRINGING TROLLEY WIRE.

A novel method of stringing trolley wire was recently used by the Sioux City Traction Company on a line lately completed from Covington to South Sioux City. The wire was live when strung, and as it was fastened in place in the hangers it was used to furnish current to the car to carry it to the next span wire.

The spool on the car on which the wire to be strung was wound, was placed in a wooden rack on wooden supports and arranged with a break, which was operated by a man standing just back of the spool. By means of this break it was possible to keep the proper tension on the wire. The car was anchored every 1,000 feet and the work performed as easily as reeling a dead wire on the ground. A half a mile of wire was recently strung in half a day, and the company states that it expects to put up all its own lines hereafter in this way.

TORONTO STREET RAILWAY ASSESSMENT CASE.

JUDGMENT has again been given in favor of the Toronto Street Railway in its appeal against the assessment on rails, wires and poles in Ward 1, Judges McGibbon, Dartnell and McDougall each concurring in the decision.

Judge McGibbon's opinion was set forth as follows:—I still retain the opinion which I expressed in my judgment in the case of the Toronto Railway Company v. the City of Toronto, in 1896, which was a case similar to the one we are now asked to adjudicate upon. Since my said judgment was delivered the judgment of the Supreme Court in the case of the Consumers' Gas Company v. Toronto v. Toronto has been delivered, and was referred to on the argument in this case, and it was contended that the judgment in that case concluded us in our judgment in this case. After reading the judgments of the Chief Justice and of Justice Gwynne in the Consumers' Gas Company of Toronto v. the City of Toronto, I am of opinion that this appeal is not determined by that judgment. I find the principle of the judgment of Gwynne, J., is founded on the compulsory power of the Gas Company to acquire and hold land. He says:—

"The sole question is as to the validity of the assessment of the mains and pipes as land and real property. Section 1 of the Act of Incorporation (II. Viet., Chap. 14) conferred upon the company power to purchase, take, and hold lands, tenements and other real property for the purposes of the company, and for the erection and construction and convenient use of the gas works of the company. By section 13 the company are empowered to break, dig up, and trench the street, etc., for the laying down of mains and pipes, etc. This section 13 operates as a legislative grant to the company of the land of the said streets, and below the surface of the said streets as the company finds it necessary to take and hold under section 1, and when the mains and pipes are placed there the land occupied by such mains is land taken and had by the company for the necessary purposes of the company, etc., and is liable to assessment as land."

The Toronto Railway Company have only a street railway privilege, for the purposes of their railway, and have neither the same powers nor property in the street as the Consumers' Gas Company have in the lands occupied or used by them for their gas works and pipes. And I do not think that the judgment in the Supreme Court in the Consumers' Gas Company case governs

this appeal. I think the appeal should be allowed, and the assessment struck from the roll.

Judge Dartnell's opinion was summed up in these terms: This appeal comes up in a slightly different shape from that heretofore disposed of by the Board of the County Judges assigned to take such cases under the assessment acts and amendments thereto. The respondents rely upon the decision of the Supreme Court in the Consumers' Gas Company v. the City of Toronto as affecting the former judgments given herein. So far as the matter of the former appeal is concerned I based my judgment largely upon the construction of the agreement between the company and the city. I express no opinion upon the effect of the recent judgment beyond saying that I cannot see how it affects the ratio decidendi of my former opinion, which I hereby reiterate and affirm.

It is again argued that the exemption from taxation which I conceive has been conferred upon the company by their agreement with the city is illegal and void. The short answer to this is that this agreement has been confirmed by an act of the legislature, and has thus been taken out of the ordinary rules which govern such assessments. The city, should I be wrong, has the option of either proceeding with the pending appeal to the Supreme Court, or by taking an appeal to the Court of Appeal, which they are now enabled to do. I think the assessment should be struck out and the appeal allowed.

Judge McDougall delivered a verbal judgment concurring in the opinions of Judges McGibbon and Dartnell.

SPARKS.

The Ottawa Electric Railway Company will borrow \$500,000 to cover the cost of recent improvements.

A report from San Francisco, Cal., states that W. B. Broadbury, a millionaire, has been sentenced to 24 hours' imprisonment on his conviction for the second time for spitting in street cars.

The Sherbrooke Street Railway Company, Sherbrooke, Que., having succeeded in securing water power privileges, have begun the work of construction of power house and surveys for road bed.

Barrister Rowan, of Toronto, was recently granted \$1,500 damages for being injured by a trolley car on Spadina avenue. The Toronto Railway Company appealed the case and Judge McMahon has given his decision in favor of the company. The plaintiff will probably appeal.

The British Columbia Electric Railway Company has been registered in British Columbia to take over the business of the Consolidated Railway Company and to construct and operate electric railways, etc., throughout British Columbia. The head office is in England. The capital of the new company is £250,000.

The month of June proved to be the heaviest in the history of the Montreal Street Railway. The earnings amounted to \$130,676.77, an increase of \$14,248.11 over June, 1896. The average daily earnings during the month were \$3,481.41, which is an average daily increase of \$215.74. The total increase in earnings for the first nine months of the fiscal year amount to \$58,803.82, the figures being \$952,120.81.

Professor George Forbes, F. R. S., who played an important part in the "harnessing of Niagara," is expected to arrive in England in a few days from Egypt, where he has been making an extensive tour in many parts of the globe with a view to reporting on the utilization of water power for the generation of electrical energy. He visited New Zealand and Africa, and while in Northern Rhodesia, in order to report on a scheme for using the water power of the Victoria Falls on the Zambesi river, to generate electricity and supply it to the various centres of population throughout Rhodesia. In Egypt, Professor Forbes had a look at the Nile cataracts, and has expressed a highly favorable opinion about utilizing their waste power for generating current.

SPARKS.

Wm. Davidson has started boiler works at Halifax, N. S.

The electric light plant at Huntingdon, Que., was recently put in successful operation.

The council of Kamloops, B. C., has offered \$4,000 for the electric light plant in that town.

The Citizens Telephone & Electric Co. are erecting a new office block at Rat Portage, Ont.

The village of Magog, Que., has recently provided the sum of \$10,000 for the purchase of an electric light plant.

Mr. Sanford, the absconding treasurer of Barrie, Ont., was also manager of the Barrie Electric Light Company.

The West Kootenay Power & Light Company are about to commence the erection of their power house at Middle Falls, on the Kootenay river.

Mr. Harry Kendrick, of Walkerville, states that he finds the ELECTRICAL NEWS more interesting each issue, and that he could not afford to be without it.

The Kiel canal is lighted over its sixty-two miles by electricity, and is the longest distance in the world lighted continuously in that way. There are 5,000 poles.

Mr. Leo B. Henderson has been appointed manager of the G. N. W. telegraph office in Ingersoll, Ont., which position was rendered vacant by the death of Mr. W. K. Burke.

The Nelson Electric Light Company, of Nelson, B. C., have placed an order for two additional 1,000-light dynamos. When installed these will give the company capacity to furnish 3,000 incandescent lights of 10-candle power.

The Fraserville Company, of Fraserville, Que., has been incorporated, to manufacture pulp, electrical machinery, etc. Among the promoters are Geo. White Fraser, Toronto; David Cook, Fraserville, and others; capital, \$50,000.

The Toronto Suburban Street Railway Company, according to its agreement, were to extend their track through the village of Weston. This has not been done, and a movement was recently commenced by the ratepayers of Weston to withdraw the franchise from the company.

The Brantford Machine and Tool Company has been organized at Brantford, Ont., and will occupy the old Watrous building. The promoters are Messrs. C. H. Watrous, F. Grabli, J. A. Rain, R. Kerr, T. A. Hollinake, W. H. Shapley, and Lloyd Harris; capital stock, \$150,000.

The Stillwell, Pierce & Smith Valve Co., of Dayton, Ohio, who are putting in the hydraulic machinery at the Montmurency Electric Power Co.'s plant near Quebec, Que., are said to have been awarded the largest contract ever given for water wheel and hydraulic machinery. The plant is for the development of the water power at Missina, N. Y., for 75,000 horse power, and will cost one million dollars. The dynamo room is 700 x 65 feet and will contain fifteen dynamos of 5,000 horse power capacity each. The current is to be used in the manufacture of calcium carbide, to produce acetylene gas.

There is said to be a strong probability that a new electric road will be built at Niagara Falls South, Ont., a franchise having been applied for by the Lundy's Lane Electric Railway Company. The chief promoters are Messrs. Henry C. Symmes and R. Paine, of Niagara Falls. It is their purpose to construct a line which will connect with the Niagara Falls Park and River railway in the park and run through several of the village streets up to Lundy's Lane battle ground and observatory.

The Montreal Star gives the following reply to the question: "What year was the electric light discovered and introduced, and in what country?" Humphrey Davy produced electric light with carbon points in 1800. Professor Tyndall lectured at the Royal Institution, London, by the light of Jules Duboscq's electric lamp in 1855. The South Foreland lighthouse was illuminated by electricity in 1858, and the French government ordered eight lighthouses to be so illuminated in April, 1861. In 1878 T. E. Edison, of New York, discovered a method of producing more light at less expense, and from that time the movement towards electric lighting rapidly advanced.

MOONLIGHT SCHEDULE FOR JULY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 8.20	A. M. 4.00	7.40
2.....	" 8.20	" 4.00	7.40
3.....	" 8.20	" 4.00	7.40
4.....	" 9.50	" 4.00	6.10
5.....	" 10.10	" 4.00	5.50
6.....	" 10.30	" 4.00	5.30
7.....	" 11.00	" 4.00	5.00
8.....	" 11.30	" 4.00	4.30
9.....	.....	" 4.00	3.50
10.....	A. M. 12.10	.....	.....
11.....	" 1.00	" 4.10	3.10
12.....	" 1.50	" 4.10	2.20
13.....	No light.	No light.	.....
14.....	No light.	No light.	.....
15.....	No light.	No light.	.....
16.....	P. M. 8.00	P. M. 9.40	1.40
17.....	" 8.00	" 10.00	2.00
18.....	" 8.00	" 10.40	2.40
19.....	" 8.00	" 11.00	3.00
20.....	" 8.50	" 11.20	3.20
21.....	" 7.50	" 11.50	4.00
22.....	" 7.50	A. M. 12.20	4.30
23.....	" 7.50	" 12.40	4.50
24.....	" 7.50	" 1.10	5.20
25.....	" 7.50	" 2.00	6.10
26.....	" 7.50	" 3.00	7.10
27.....	" 7.50	" 4.10	8.20
28.....	" 7.50	" 4.10	8.20
29.....	" 7.40	" 4.10	8.30
30.....	" 7.40	" 4.10	8.30
31.....	" 7.40	" 4.10	8.30

Total, 146.10

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CANADIAN
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MR. SAMUEL J. T. BROWN.

MEMBERS of the Canadian Electrical Association and persons connected with the electrical interests in Western Ontario will have no difficulty in recognizing in the accompanying portrait the smiling features of Mr. S. J. T. Brown, local manager of the Bell Telephone Co. at London, Ont. Mr. Brown was born in Hertford County, England, on October 3, 1852. In 1869 he came to Canada and settled in Hamilton, where he became engaged in the building business. In 1873 he entered the employ of the Bell Telephone Company under Mr. Hugh C. Baker. In 1883 he was appointed travelling agent to organize exchanges and put in plants in the district west of Kingston. He met with so much success that the company promoted him to the position of manager of the London branch, October, 1891. The numerous improvements in the telephone service in the city since that date are an evidence of the thorough appreciation which he has of his business. Mr. Brown has always taken an active interest in the welfare of the city, and is highly respected by all who know him.

ECONOMY OF ELECTRICAL PRODUCTIONS.

MANY of the commercial chemicals now in general use are made at much cheaper rates than formerly, says an exchange, because of the economy of electrical production. A large percentage of the metals can now be reduced from their ores by electrolytic methods. The production, refining, purifying, etc., of many products not essentially chemical, such, for example, as sugar, molasses, beer, starch, beet-root juice, etc., is now accomplished electrolytically. Cotton is picked and bleached, leather is tanned, white lead is made, meat is preserved, ozone is generated, acetylene gas is produced, safes are broken into, car wheels are tested, graphite is formed, and diamonds are manufactured by either the direct or indirect action of the current; gold, silver, iron, zinc, lead, copper, tin, aluminum, nickel, bismuth, antimony, are all either mined, refined or separated from their ores, and in some cases actually produced by the magical properties of the electric current. Power is transmitted, farms are worked, boats and land carriages are propelled, oil wells are made to increase their flow, the stage is made more spectacular, watercourses are disinfected, and hitherto impenetrable substances are rendered transparent, all

by means of electrical development. The list is not carried beyond the achievements of a year or two past, nor is it meant to include such apparatus as the telephone, telegraph, phonograph, or other widely-spread factors of electrical development.

EDISON'S VIEW OF HORSELESS CARRIAGES.

A REPORTER of a daily paper interviewed Edison recently upon the subject of horseless carriages. His opinion is that the problem rests on the construction of cheaper and lighter motors. Over 2,000 men, he says, are at work in this country alone trying to invent better motors for horseless vehicles. Hundreds of others in Europe are also engaged in the same task. The automobile is bound to be in general use beforelong. Take the bicycle, for instance. The high grade wheels which cost \$100 each to-day will in a few years at best drop to \$50, and machines that can now be bought for from \$50 to \$75 apiece will cost only \$15 or \$20. The same thing will be the outcome of the experiment with horseless carriages. The motors now cost from \$250 to \$350 each. The motors will also be made smaller and can be more easily manipulated. Then tricycles and light load vehicles can be put on the market at a cost of \$100 to \$125 each; a serviceable light vehicle to carry two, or even four, people can be made after the principle of the tricycle at a cost of from \$100 to \$125. In the construction of the motor there are three different kinds of power to consider—gas, petroleum and electricity. Electricity should be the best and cheapest. The most successful automobiles made thus far are those in which electric motors are used. They can go twenty-five miles or more without being re-charged at the rate of ten miles an hour. Delivery waggons, express waggons, broughams and all of the heavier class of vehicles can be driven as easily by a storage battery as any other kind if the battery is improved sufficiently, and that will unquestionably be done.



MR. SAMUEL J. T. BROWN.

Mr. G. Sage, engineer, Clinton, states on renewing his subscription to the ELECTRICAL NEWS, that no up-to-date engineer can afford to be without it.

The Jenckes Machine Co., of Sherbrooke, recently shipped to the Asbestos & Asbestic Co., of Danville, one of their 20-drill air compressors, together with three high-speed crushing rolls and two picking tables, being a plant required by the Asbestos Co. in connection with the extension of their operations.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

By the kindness of Mr. James Milne, the instructor in this department, we are enabled to print the answers to the problems given the students in Applied Mechanics at the recent examinations of the above school. The questions were published in the July issue of the ELECTRICAL NEWS, and the answers are as follows:

APPLIED MECHANICS.

ELEMENTARY.

ANSWERS:-

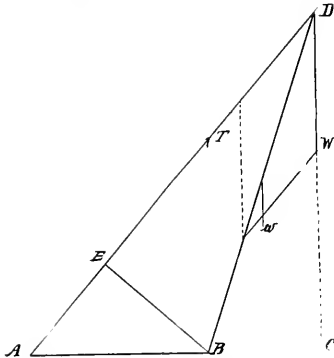
1. $32^2 \frac{2}{3}$.
2. 14062.5 ft. pds.
3. 30063 lbs.
4. .718 or 71.8% efficiency.
5. Top 1,000 lbs., bottom, 5,000 lbs., sides 3,000 lbs.
6. B. W. $4740 \frac{1}{4}$ lbs. very nearly.
7. 12" and 48" diam. 30 and 120 teeth respectively.
8. 22 cwt., 28 cwt., 11.2 feet from support having 22 cwt. reaction.
9. 15.13 lbs.
10. 200 lbs. $7 \frac{1}{2}$ lbs.
11. 55.8 lbs. 806 lbs.
12. 64. 160.

ADVANCED.

13. Let R = Radius of large sheave.
r = radius of small sheave.
P = Pull in lbs.
W = Weight to be lifted.
$$W = \frac{2PR}{R-r} = 1,200 \text{ lbs.}$$

Efficiency = useful work done. Total work expended.

14.



Tension \cdot E B = W. B C + w. $\frac{B C}{2} = 31$ B C.

Find E B and B C.

Area of Triangle A B D = 95 sq. ft.

$$\therefore \frac{A D \cdot E B}{2} = 95 \text{ sq. ft.}$$

$$E B = 7.6 \text{ feet.}$$

$$\text{Again } \frac{A B \cdot C D}{2} = 95 \text{ or } C D = 19'$$

$$\text{But } B C = \sqrt{20^2 - 19^2} = 6.4' \text{ nearly}$$

$$\text{Tension } \cdot$$

$$\text{Tension } \cdot$$

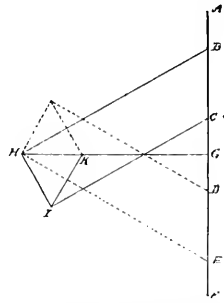
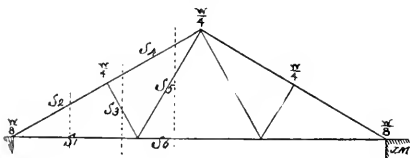
$$\text{Tension } \cdot$$

By parallelogram of forces the thrust on the gib as measured on diagram is 52.5 cwt.

15. 9,000 lbs.

16. When on the point of lowering the weight is 2380 lbs., and when on the point of raising the weight is 220 lbs.

17.



Let B_1, B_2, B_3 , etc., be the angles, made by

S_1, S_2, S_3 , etc., with the vertical

$$\sin B_2 = \sin B_4 = \cos B_3 = \cos B_5$$

WESTERN ONTARIO LIGHTING PLANTS.

Our travelling representative has furnished the following descriptions of lighting plants in Western Ontario, as an adjunct to those which appeared in our July issue:

FERGUS ELECTRIC LIGHT AND POWER COMPANY.

The Fergus electric light and power plant is owned by Dr. Groves, of Fergus, and was installed in 1891, the power house being situated in Dr. Groves' mills. Besides supplying light to Fergus, the company in 1893 extended their line to Elora, and have since supplied that town with street and residential lighting. They also supply power for motors.

The company have at present 24 miles of wire, 800 incandescent lamps and 40 arc street lights. The plant consists of Reliance dynamo of 2080 volts, and Thomson-Houston alternator, all switch-board apparatus being from Reliance works. One of the special features of this plant is the exciting of alternator direct from arc circuit without the use of a separate exciter. There is a well equipped machine shop in connection with the plant furnished with Bertram drill lathe and full complement of tools, in which all repairs are made and arc light winding done. Power is furnished by a Brown tandem-compound, 9 x 14, 24" stroke, and Porter & Allen 10 1/4 x 20 high speed engines, controlled by Porter governor, steam being supplied by two boilers, one 52 in. x 14 ft. and one 48 in. x 14 ft. The engine room is equipped with Northey fire pump and fire hose and an indicator outfit. This plant has had in use a jet condensor, but owing to the hardness of the water they are now putting in a new surface condensor.

Mr. Gibson Groves, the manager of the plant, was born near Fergus on the 20th of June, 1857. After



MR. GIBSON GROVES.

leaving public school he resided for several years in Manitoba, engaging in different lines of business. He always took an active interest in engineering and electrical matters, and in 1893 took charge of the above plant, which, under his progressive and energetic management, has reached a high state of efficiency.

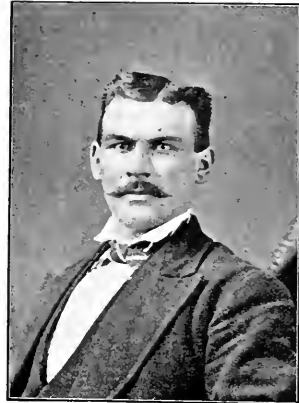
SEAFORTH ELECTRIC LIGHT, HEAT AND POWER COMPANY.

The plant of the Seaforth Electric Light, Heat & Power Company has been in operation since 1894, and is at present supplying 1,160 incandescent lights, forty-four 1,000 candle power arc and twenty 2,000 c. p. street arc lamps.

The power house is a commodious brick building,

with excellent ventilation, the offices and store-rooms being in the front. The floor of the dynamo room is covered with oil cloth, and the boiler room is built adjoining, with concrete floor. The basement contains toilet and bath room, large water tank and oil filter. Power is generated by a United Electric Improvement Co.'s alternator and Ball arc dynamo. The switch-board is fitted with instruments of same make, with exception of a Carpenter's enamelled rheostat. Two 85 h. p. high speed Robb engines and two 70 h. p. Robb boilers, Austin water heater and Northey pump complete the power apparatus.

Mr. A. H. Ingram, manager for the company, whose portrait we present, has had charge of the plant since



MR. A. H. INGRAM.

its installation. Mr. Ingram is a native Canadian, now 35 years of age, and was born in the county of Huron. After leaving the public schools, and having a liking for mechanical pursuits, he followed engineering, and with the advent of electricity into commercial use, obtained a position with the Brush Company, of Detroit, with which firm he was engaged for over two years, severing his connection with them to take his present position. He operated the plant for about four years for the corporation, and returned to the position when the present company took over the business. He is a progressive and energetic manager. Mr. Ingram now enjoys more than a local reputation, and any visitor to the plant under his charge will be convinced that the reputation he enjoys is well deserved. He is ably assisted by his engineer, Mr. I. Moddlin, and his assistants, Messrs. Darling, Chesney and Smiley.

Under Mr. Ingram's management this company are branching out into the manufacture of dynamos, having already supplied several small plants with generators.

SOUTHAMPTON AND PORT ELGIN ELECTRIC LIGHT PLANT.

Messrs. Kilmer, Cowan & Co., of Southampton, Ont., who have secured a franchise for electric lighting the towns of Southampton and Port Elgin, Ont., are now installing their new plant at Denny's Dam, on the Saugeen river, about 2 1/2 miles north of Southampton, from which they will supply both light and power to above towns.

This firm having purchased the water privilege at what was known as Denny's hull, have erected a two-storey power house, 20 x 38 feet, finished in hardwood, and have rebuilt and enlarged the flume, and are put-

ting in a Kennedy 66 in. special water wheel, with Kennedy governor. They have a 10½ foot head of water, and the privilege to raise to 16 feet, giving them 1,500 h. p. For present lighting they have installed a 75 k. w. monocyclic Canadian General generator, with other instruments. They have at present about fifteen miles of wire, and expect to transmit to other towns in the vicinity. They are using No. 4 wire on the line to Port Elgin and No. 6 to Southampton, and furnish about 1,200 incandescent lights, but are putting in a number of 50 c. p. incandescent street lights.

Mr. C. E. Kilmer, the manager of the plant, is a native Canadian, and an experienced electrician, having had several years experience with the Canadian General Company at Peterboro.

PAISLEY ELECTRIC LIGHT PLANT.

This plant has been operated by water power for about two years, and is owned and managed by Mr. D. McIntyre, of Paisley. The power house is situated on the north branch of the Saugeen river about two miles from the town, and is equipped with a Leffel 52 in. water wheel and a 750 light Royal generator, with instruments, from the Royal Electric Company. For transmitting Mr. McIntyre has already put in about seven miles of wire, and is supplying about 200 lights. With the capacity of the plant it is needless to remark that the citizens of Paisley are getting an efficient service.

ELECTRICITY APPLIED TO GOLD MINING.

THE big power plant at Blue Lakes city, Amador county, Cal., is nearing completion and will shortly be ready to transmit light and power along 32 miles of the mother lode in Amador and Calaveras counties. Large reservoirs have been built in Slabtown, two miles from the site of the power building. Two 2 phase generators will be shipped from Massachusetts, together with the other electrical apparatus, in a few days. It is claimed that this will be 60 per cent. cheaper than the power now used at the mines. The application of electricity to the working of ore is becoming general in all mining regions. Electricity, of New York, says concerning the subject:

"Two important undertakings, which have somewhat recently been before the British investor, have for their object the generation and supply of electrical power for use in gold mining. One of the schemes is for the extensive gold mining districts of Western Australia, particularly the Coolgardie neighborhood, the matter having been gone into very carefully by English experts who have advised the Westralian Electrical Company. It is thought that the growing gold mining industry of Westralia will afford satisfactory instances for the successful application of electric power transmitted over distances.

The other undertaking has been, for some time, in course of carrying out. It is that of the Rand Central Electric Works, which supplies electric power to the gold mines of the Rand district in the South African Republic. The Siemens & Halske Company have been very closely identified with this scheme, but there are a number of English shareholders, Sir Charles Rivers-Wilson being the chairman of the company. The capacity of the plant put down, which is equal to about 2,100 horse power, has been applied for at an average of about £45 per horse-power per annum delivered, including wires and fittings. As this is a cheaper rate than steam power can be obtained it is not very sur-

prising that the demand should have been so ready. The company expects to find it necessary very shortly to extend its plant, and sees its way to good returns on its capital. There are four three-phase generators in position, these being direct-driven by vertical triple-expansion marine-type engines, having a maximum break horse power of 1,200. Each dynamo weighs 30 tons, and is constructed in four pieces. Eight multi-tubular boilers, with 200 tubes each, supply the steam. Each is of 600 horse-power, and has 9,300 square feet of heating surface. Only three sets of the plant will be worked at first, the fourth being held in reserve for a time. Some of the mines supplied are situated over 20 miles from the generating station. Current is generated in the dynamos at 700 volts, is raised by means of step-up transformers to 10,000 volts, and at the mines is reduced by step-down transformers to 120 volts for lighting and 240 to 500 volts for motor work."

H. M. Chance, in a lecture before the Engineers' Club of Philadelphia, not long ago, gave a description of the various processes of extracting gold from ores by electricity. He divided them into six classes, each involving a different principle or method of application. The classes are:

1. Electro-magnetic.
2. Electro-solvent.
3. Electro-amalgamating.
4. Electro-precipitating.
5. Electro-inductional.
6. Electro-smelting.

The first class employs electro-magnets to remove magnetic material from the gold with which it is associated. In the second class the current is used to assist in dissolving the gold from ores by means of chemical solvents of gold. In the third class the current is passed through the amalgamated plates or mercury to facilitate amalgamation. The processes of the fourth class are electrolytic, the gold being electrically deposited from its chemical solutions. These processes are extensively used in South Africa and to some extent in this country. The fifth method aims to remove gold particles from other materials by the inductive action of high frequency alternating currents. The sixth method, that of electric smelting, promises well, provided the cost can be reduced to that of ordinary smelting processes.

THE NEW TELEPHONE GIRL.

SHE was a new girl at the central telephone exchange. Her previous experience in this big and busy world had been behind the counter at Chintz & Chally's. Nevertheless, she was a pleasant-spoken young lady and amiability was written all over her nature. She had adopted as her motto the touching sentence: "We try to please," and she honestly tried to live up to it. There was a ring at the bell. She applied her ear to the instrument and asked, sweetly:

"What number, please?"

"Let me have No. 474."

"I am sorry that No. 474 is busy now," she replied. "You can have No. 473 or No. 475 if you wish."

The individual at the other end of the wire hung up his receiver and used language which plainly showed that all efforts to please do not necessarily succeed.—Harper's Bazaar.

The Electrical Supply Company of Hamilton, Limited, has been incorporated, with a capital of \$20,000. The promoters are: John Wesley Van Dyke, of Grimsby, manufacturer, and John Sintzel, tailor; Joseph Overholt, dentist; William Gilzean Read, merchant, and George Thompson Simpson, electrician, all of Hamilton.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

ANNUAL CONVENTION.

THE annual convention of the Canadian Association of Stationary Engineers will be held at Brockville, Ont., on Thursday and Friday, the 19th and 20th instants. The meeting is expected to be especially interesting, as some important questions will be discussed, one being the proposed Dominion license law. A paper on "The Indicator," prepared by Mr. G. B. Risler, of London, will be presented, and it is possible other essays on engineering subjects will be forthcoming.

STRATFORD NO. 3.

The features of the president of the above association, Mr. John Hoy, are herewith portrayed. Mr. Hoy is an active association worker, and puts forth every effort to make the meetings interesting. He was born about ten miles from Stratford, in the township of South East Hope, on September 28th, 1854. At the age of 19 years he learned the trade of machinist, afterwards becoming engineer at the works of Thomp-



MR. JOHN HOY.

son, Williams & Co., remaining in that position for nine years. For a time he was engaged at Weston, Ont., but upon returning to Stratford he accepted the position of engineer for Messrs. Dufton & Sons, which he has occupied for the past thirteen years. He has therefore been in the employ of a steam plant for twenty-three years, and is a thoroughly reliable engineer.

LONDON NO. 5.

The above branch of the C. A. S. E. have made a somewhat new departure in association work. A number of engineering questions have been prepared by the examining committee, a copy of which has been furnished to each member. Three prizes will be awarded to the winners. The questions were prepared by Mr. G. B. Risler, of the Advertiser office, who is also furnishing the prizes. Mr. Potter, chief engineer of the London street railway, will act as judge. The answers are to be received in writing before 8 p. m. of August 19th, and the result is looked forward to with much interest.

BROCKVILLE NO. 15.

Mr. J. Aikens, secretary of Brockville No. 15, writes: At our last meeting the election of officers for the ensuing year was held, with the following result: President,

J. Grundy; past president, A. Franklin; vice-president, C. L. Bertrand; 2nd vice-president, F. Andrews; recording secretary, J. Aikens; financial secretary, Wm. Robinson; treasurer, J. McCaw; conductor, W. S. Baverstock; door-keeper, E. Mortimer; trustees, E. Carr, F. Devine, J. McRitchie; delegates to convention, E. Andrews, F. Wilkinson. The programme for the convention is not yet completed.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

THE annual meeting of the Ontario Association of Stationary Engineers was held in Toronto on Monday, May 31st last. President Arthur Ames, of Brantford, called the meeting to order at 11 a. m.

The minutes of the previous meeting were read and approved, on motion of Bros. Mackie and Devlin. The president delivered the following address:

GENTLEMEN,—On the occasion of our seventh annual meeting, I feel it my duty to thank the officers and members of this association for having shown the confidence reposed in me by re-electing me for a second term to the honorable position as president of the association. It is with the greatest pleasure that I note the growing interest with which our annual meeting is looked forward to by all. I am sure that I but voice the sentiment of all the members when I express the sincere regret occasioned by the absence, through illness, of our worthy registrar, Mr. A. E. Edkins. I am happy to state, however, that he is now convalescent, and we may look forward to seeing him with us again ere long. In his absence, the duties of his position have fallen to Mr. A. M. Wickens, who has so ably taken up the work with all his old-timed vigor, and has managed the business connected with the office in a manner highly creditable to himself and to the society in general, and it must be encouraging to remember how deep an interest the older members still retain in the society.

The business to be brought before you will consist of, as on previous occasions, the election of officers to the board to replace the retiring members whose time have expired. In connection with this matter it is scarcely necessary to impress upon you the importance and desirability of electing, to fill the vacancies, members who have the interests of the association at heart, for, as you will readily understand, its future success as an association depends, to a very great extent, upon the perseverance and intelligence of the officers. In this connection, I may congratulate the officers and members of the outgoing board on the fact that, during the past years, no complaint has reached me respecting any certificate holder, either for neglect of duty, intoxication or other unbecoming conduct, consequently we have not had to revoke any certificates.

I would draw your attention to the fact that the membership of the association has not increased to the extent that it might have during the past year, but it is nevertheless gratifying to note that the best men throughout the province have availed themselves of the privileges offered by the association and procured certificates on their own merits. The importance of this statement is shown by the fact that manufacturers all over the province now require engineers holding Ontario certificates, and every steam plant of any consequence is now managed by a member of this association—a most encouraging sign.

The all important question of legislation is again before us. A short time ago, as you no doubt remember, a joint committee of the Canadian Association and Ontario Association was appointed to draught a bill respecting the inspection of steam boilers and the licensing of engineers in the Dominion. This was done satisfactorily to the committee, and at the meeting in question Messrs. A. M. Wickens, Jas. Devlin and myself were delegated to introduce the bill and explain its purposes. As an association we are deeply indebted to Mr. Jas. Sutherland, M. P. for North Oxford, who so courteously, at our solicitation, consented to introduce the measure in the House, and to draw to the attention of the members of that body the great and increasing importance connected with the proper inspection of steam boilers and the qualifications of the engineers in charge thereof. The bill up to the present time has passed its second reading, which you will be pleased to receive as an assurance that the measure is being duly considered at the hands of the Government. I may say, however, that owing to the great pressure of business at Ottawa connected with the tariff, etc., and owing partially to the introduction of the measure late in the session, the possibilities of securing its passage were lessened, but great hopes are entertained of obtaining the necessary legislation early in the session of 1898.

In conclusion, I wish to once more earnestly and sincerely thank the members of this association for the very great confidence reposed in me and the honor shown me during the time I have held the position of president of this association, and I do this the more earnestly knowing that this is the last opportunity I will have of thanking you individually and collectively for the hearty co-operation and support I have received at your hands in connection with the various duties that have fallen to my position during my term of office. I need hardly say that I will ever have the best interests and welfare of the association at heart, and

should the opportunity ever arise I will be always ready and willing to do all that lies in my power to further its interest to the utmost.

Mr. A. M. Wickins, acting registrar, presented his report. The business of the year was stated to be satisfactory. Regret was expressed that Bro. Edkins was unable to be present. The report also said: The number of new certificates issued for the year of all grades is 70. There have been 17 certificates raised to a higher grade. We have issued 680 certificates, some of which have been cancelled for non-payment of renewals and a few have been blanked by their holders passing to the great beyond, leaving us with 634 certificate holders in good standing. The financial report is as follows:

RECEIPTS.		DISBURSEMENTS.	
New Certificates and		To Paid Treasurer.....	\$158 47
Raises.....	\$200 25	" Paid Examination Fees.....	187 55
Renewals.....	229 75	" Postage, Printing and	
Cash from Treasurer.....	35 00	Legislation.....	106 69
		" Cash on Hand.....	12 29
	\$405 00		\$465 00

The treasurer's report showed that \$158.47 had been received from the Registrar, which with the balance on hand May 31, 1896, made an income of \$393.31. The expenditure was as follows:

1896.		
June 1—Board Meeting, Galt.....	\$	88 64
Caretaker and Hall Rent.....		3 00
Paid Treasurer Salary.....		10 00
Percentage on Renewals.....		75
6—Paid Registrar.....		25 00
Nov. 26—Paid Registrar.....		35 00
1897.		
Mar. 17—Legislation Committee Expenses.....		44 00
May —Legislation Committee, Expenses to Ottawa.....		51 00
May 30—Postage and Expenses.....		3 75
	\$281 14	
Balance on Hand.....		111 17
	\$393 31	

The standing committees were then appointed as follows: Committee on good of the order—O. P. St. John, F. W. Donaldson, W. G. Blackgrove, Jas. Devlin and John Bain. The legislative committee were re-appointed, and on motion of Bros. Donaldson and Mackie were given power to add to their number. Committee on mileage, Bros. Jas. Devlin, Robt. Mackie and Wm. Sutton.

On motion of Bros. Mackie and Bain, it was resolved that the president be empowered to appoint a member to investigate and report on any boiler explosion that may occur, should he deem it advisable so to do.

It was moved by Bro. Devlin, seconded by T. Elliott, that a petition for a Dominion license law be forwarded to the members in the different towns, with a request to have them circulated, signed and forwarded to Ottawa.

Mr. Mooring moved, seconded by Mr. Wickens, that Bros. Mitchell, Dandie and Bain be appointed a committee on transportation for the next regular meeting at Oshawa.

The treasurer was granted the sum of \$10 for his services.

On motion of Bros. Mitchell and Devlin, a uniform price for inspection of a steam plant, was agreed upon, said price to be \$4 if the plant is situated in the town where such examiner lives; if not, railway fare and hotel expenses to be added.

ELECTION OF OFFICERS.

For president, Bros. T. W. Mitchell and O. P. St. John were nominated, Bro. Mitchell being elected.

For vice-president, Bros. St. John and Donaldson were nominated, the latter being successful.

Bros. Wickens and Mackie were elected by acclamation to the respective offices of registrar and treasurer.

Hamilton, Brantford and Oshawa were all strongly supported by the members as the next meeting place, with the result that Oshawa was decided upon.

On motion of Bros. Devlin and Blackgrove, the regular meeting was fixed for the first Monday after the 24th of May.

ELECTION OF BOARD MEMBERS.

The retiring members of the board were Bros. Mackie, Edkins, Philip and Wickens.

Moved by Bros. Elliott and Donaldson that the retiring members be re-elected by acclamation. Lost.

Nominations were made as follows: Bros. Edkins, St. John, Mackie, Mooring, Philip and Blackgrove.

Upon a vote being taken, Bros. Edkins, Mackie, St. John and Wickens were declared elected.

The standing committee here reported, which was then followed by a report from the committee on mileage, recommending that the sum of \$75.19 be paid board members for mileage.

The committee on the good of the order request all certificate holders to use their best endeavors in setting forth the advantages of taking out certificates, and the usefulness of a Dominion license law to engineers and steam users.

PERSONAL.

Mr. Wm. Cross, C.E., was recently appointed to take charge of the waterworks plant at Calgary, Alta.

Mr. John Davis, of the Metropolitan Railway, North Toronto, has recently passed through a severe illness, from which he is now recovering.

Mr. Fred B. Robb, of Amherst, N.S., was drowned while bathing near Wallace. Deceased was secretary-treasurer of the Robb Engineering Company.

Mr. Wm. F. Chapman, chief engineer for the Canada Carriage Company, Brockville, and executive secretary of the Canadian Association of Stationary Engineers, was recently married to Mrs. Alfred.

TRADE NOTES.

The Lucky Jim Gold Mining Co., of Sandon, B.C., have placed an order with the Jenckes Machine Co., of Sherbrooke, through their Rossland branch, for the ironwork for one three-wheel tramway.

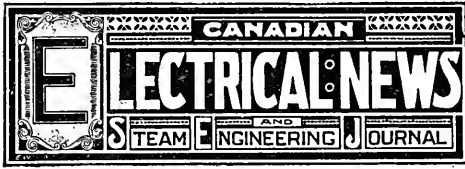
The Colonna Gold Mining Co., of Rossland, are putting in an air pipe line to connect their two properties. This has been bought through the Rossland branch of the Jenckes Machine Co., of Sherbrooke, Que.

We have received a copy of the 1897 circular of information of the International Correspondence School of Electricity, of Scranton, Pa. The thorough system of this school is making for it a world-wide reputation, and those contemplating home study should send for full information.

The Sherbrooke Street Railway Co. have closed a contract with the Jenckes Machine Co. for one of their 45-inch Crocker turbines, with tubing and wheel cases complete, horizontal setting, for direct connection to an electric generator, which is being furnished by the General Electric Co.

The firm of Patterson & Corbin, street car builders, St. Catharines, Ont., has failed. Possession of the estate has been taken by the bank under power of mortgage, while the municipality placed a bailiff in charge for taxes. The firm for several years did a successful trade, but for two or three years past have been at a stand-still.

We are in receipt of an invitation to the nineteenth annual Rhode Island Clam Dinner tendered to the electrical fraternity by Mr. Eugene F. Phillips, president of the Eugene F. Phillips Electrical Works. The event takes place at the Pomham Club, Providence, R. I., on August 21st, and will no doubt prove as enjoyable as similar occasions in the past.



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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 25th day of the month.

SUBSCRIPTIONS.

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Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publisher should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 6 Victoria street. G. C. Mooring, President; T. Eversfield, Vice-President; J. W. Marr, Recording Secretary.

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ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. R. Drouin, President; Alfred L. Tour, Secretary, 368 Delisle street, St. Cuneo, Que.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

HAMILTON BRANCH NO. 2.—Meets 1st and 3rd Friday each month in McCabe's Hall. Wm. Norris, President; G. Mackie, Vice-President; Jos. Ironside, Recording Secretary, Market St.

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LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. D. G. Campbell, President; B. Bright, Vice-President; W. Blythe, Secretary.

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OTTAWA BRANCH NO. 7.—Meets every second and fourth Saturday in each month, in Horbridge's hall, Rideau street; Frank Robert, President; T. G. Johnson, Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday in each month at 8 p.m. J. R. Utley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Herliu, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p.m. President, F. Simmons; Vice-President, C. Assestine; Secretary, J. L. Orr.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outwaite, President; W. Forster, Vice-President; A. E. McCallum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, John Grundy; Vice-President, C. L. Bertrand; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

The Russian Electro-Technical Society is said to be arranging for an electrical exhibition in St. Petersburg in 1899, at which every kind of electrical device will be granted admission. The expenses are to be borne by the government, the city authorities and the above-named society. This exhibition should be taken advantage of to make known in Russia the merits of Canadian manufactured electrical goods.

Engineering Education.

The fifth annual meeting of the Society for the Promotion of Engineering Education will be held in the School of Practical Science, Toronto, on the 16th, 17th and 18th of the present month. Special rates have been granted by the railways to delegates to this convention, and a number of pleasure excursions have also been arranged. Mr. Frank Callen, the secretary, may be found at the Arlington Hotel during the convention.

Developments in Telegraphy.

Persons connected with the electric lighting and power and telephone interests have shown a disposition to regard the telegraph system as somewhat of a back number. The remark has frequently been heard that the telegraph has reached the limits of its development, and consequently attracts but little notice. Recent developments go to prove, however, that telegraphy is likely to keep fully abreast, if not in advance of improvements in other departments of the electrical field. Reference was recently made in these columns to experiments carried out under the direction of the British post office authorities for telegraphing through space without the aid of wires. Since then the celebrated electrical inventor, Nikola Tesla, of New York, has been devoting his attention to the subject, and claims to have developed apparatus which enables him to telegraph successfully a distance of twenty miles through

the earth. Mr. Tesla has demonstrated to his entire satisfaction by means of the rudimentary apparatus at present at command that communication can be carried on with any part of the globe, and he is about to begin the construction of improved appliances for the accomplishment of this object. The character of these appliances has not been disclosed.

Illumination of Niagara Falls.

THE delegates to the recent convention of the Canadian Electrical Association at Niagara Falls heard from the old residents of that locality descriptions of the beautiful effects which resulted from the illumination of the cataract by means of electricity nearly twenty years ago. Many were the regrets expressed that when the lands surrounding the falls came under the control of the government these artificial effects ceased. Our readers will be interested in knowing that the Acetylene Light, Heat and Power Co. have now in operation a system of illumination by means of acetylene gas. Half inch pipe connects three Naphey generators with fifteen large locomotive headlights placed in various positions. It is said that the light does not penetrate very far, and that no attempt is made to light up the Horse Shoe falls, but only the river close to the American shore.

The Canadian Electrical Association.

THE late convention of the Canadian Electrical Association at Niagara was both interesting and instructive, in that the several papers presented gave rise to especially valuable discussions, and it is gratifying to note that, in these discussions, members associated purely with the operating branch of electricity took part almost as actively as those representing the several manufacturing companies. This evinces a growing interest in the C. E. A. as the representative electrical association of Canada that augurs well for the future of the association, not only as affording yearly a pleasant re-union, but also as an aid in raising the standard of electrical operating by the exchange of experiences and opinions. Such an association should be recognized as an absolute necessity, where, as in the business of electrical lighting and power distribution, the most efficient and economical means of generating and the most remunerative system of operating and managing generally, is not a matter of exact science, but is largely empirical, and varies under different local conditions. Thus it is only by obtaining the views, founded on experience of observers operating under all kinds of varied conditions, that any comprehensive idea can be formed of the most favorable ways of operating.

The Gorge Road.

WE were much impressed on the occasion of the recent electrical conventions at Niagara Falls with the advantages which the Niagara Falls Park and River Railway has over its American rival, known as the "Gorge Road." As most of our readers know, the Canadian road runs close to the edge of the bank of the gorge, and affords a panoramic view of the river and surrounding scenery which is positively delightful. The American road winds along the face of the cliff near its base, the object being to bring sight-seers within as close range as possible of the rapids. The Canadian road enjoys the advantage of being safer for the sight-seer and less costly to maintain in operation. The face of the cliff

out of which a road bed has been cut for the Gorge road has been rendered almost as rotten as pumice stone by being constantly percolated with water. As a result, pieces of rock are continually becoming detached from the upper face of the cliff and falling upon the road-bed of the railway below. To prevent as far as possible accidents from this cause, a staff of fifty workmen is constantly employed in keeping the road-bed in repair. The greatest difficulty is experienced in the spring, at which time the services of several hundred men have sometimes been required. The great expense thus imposed upon the management, coupled with the fact that the period of operation is only about four months each year, makes it extremely doubtful if the enterprise can be made to pay expenses. There is also the possibility, if not probability, that an accident, frightful to contemplate, may some day occur in spite of all the precautions which are or can be taken.

[Since the above was written a collision has occurred on the Gorge road in which nearly twenty persons were injured, some seriously. To allow of repairs being made to one of the tracks both up and down cars were said to be using the inside track.]

Central Station Management.

MR. Armstrong's paper, read at the recent convention of the Canadian Electrical Association, on "Why Some Lighting Plants Do Not Pay," was but the introductory note to a subject on which volumes might well be written, and which we are glad to see is claiming the attention of energetic central station owners. Mr. Armstrong gives, in very unmistakable language, one of the principal reasons for absence of profits, when he says: "There is no industry representing an equivalent money investment and possibility of public service which is so generally managed by men who know little or nothing about it." In an electric lighting plant we have a factory that contains two perfectly different kinds of machinery, the object of which is to generate an invisible, imponderable force out of so simple a material as coal. Both the steam engine and the electric dynamo are lightly developed scientific machines, and the economical generation of steam in a boiler is thought a fit problem for the attention of highly educated engineers. And yet in the large majority of cases a mechanic, whose education has not included any scientific instruction, and whose experience is limited to repairing broken parts, is placed in the responsible position of manager or electrician. It is not fair to such a man to put him in a position requiring much higher order of technical knowledge and business ability than it is in the least degree possible for him to possess, and the wonder is that central station owners are so blind to their own interests as to follow such a course.

Apparent Inconsistency.

WITHIN the last very few weeks there was a proposition made to appoint an "electrical engineer" on the staff of the city engineer, Hamilton. This proposition was defeated on the ground that such a person was not required, as any mechanic could do the necessary work. Now, the work may, or may not, have been such as to call for the exercise of great technical skill, but the decision seems to indicate the estimation in which engineers are held in Canada. When will the public learn to know the difference between a mechanic and an engineer? They send their sons to McGill or the School of

Practical Science to become electrical engineers, because, as they say, "Electricity is the thing of the future," and they evince their confidence in the advantage of a thoroughly technical and scientific education by preferring the service of a mechanic whose school was the bench and whose technical qualification is the willingness to work for \$40 a month, to those of the certificated graduate whom they themselves have caused to be filled with apparently utterly useless knowledge at considerable expense. Is there really nothing in electrical engineering that is not instinctively known by an uneducated mechanic? Why support such schools as we have in Toronto, Montreal and elsewhere if what they teach is of no value? Why waste time, brains and money in teaching one young man at college what another young man is paid for absorbing unconsciously at a bench? But, on the other hand, if a technical education does specially fit a man for a particular profession, in the name of common sense why not recognize and profit by the probability that he knows more about his work than another man who has made no study of it?

MR. GEORGE BLACK,

SUPERINTENDENT GREAT NORTHWESTERN TELEGRAPH COMPANY, HAMILTON.

THE subject of this sketch was born of Scotch parents in the City of Montreal on June 19th, 1838, in which city he received his education. His ambition was to be an engine builder, but owing to his delicate health his friends deterred him from following that vocation. After spending three years in commercial life he entered the service of the Montreal Telegraph Company as entry clerk, in November, 1854. He was given the option of remaining at the head office or taking an agency, and



MR. GEORGE BLACK.

choosing the latter, was placed in charge of the St. Hyacinthe, Que., office, working for the G. T. R. and M. T. companies until April, 1855, and in September of the same year was promoted to the Brockville agency, the business of which doubled in the course of a few months. Mr. Black yet speaks of his surprise when one morning the general superintendent called him up and conveyed to him the thanks of the board of directors for the manner in which he had conducted the business of the office, and informed him that an increase in his salary had been decided upon.

On October 1st, 1858, Mr. Black was promoted to the management of the Hamilton office, where he remained till the company was merged in the Great Northwestern Company, and since that time he has continued as manager for the new company. So attached was he to his old company that he refused an offer to go into opposition in 1869 at nearly three times the salary he then received. A couple of offers since to leave the service were also declined.

Mr. Black has taken a lively interest in all improvements in telegraphy, and has watched with deep interest the development of electrical inventions and their application to the use of the public. In 1874 he and a friend

invented and applied for an American patent on a method of signalling automatically to and from trains in motion, to prevent accidents, or signal detects in tracks, bridges, etc. This application was killed in the patent office by a mere technicality, no interference being raised which could not be overcome, and though proceedings could have been started over again, the inventors feared that other obstructions would be raised and abandoned the case. This patent anticipated the trolley wire, and when railway collisions are reported Mr. Black always feels that they might have been avoided by the use of his system.

When the Bell telephone came before the public Mr. Black accepted the agency for Hamilton and vicinity, and helped to popularize the new invention by public exhibitions, etc. While experimenting with the telephone he discovered a method of using the telegraph and telephone on the same wire simultaneously. He, in conjunction with Dr. Rosebrugh, of Toronto, patented this method, which was issued in 1878. This was the first method of simultaneous telegraphic telephony invented, and when subsequently improved worked perfectly between Toronto and Hamilton and at other places for a lengthened period. Prof. Rysselberge, of Belgium, got credit and praise for this invention, but his method, which is somewhat similar, was not announced till some years later.

Mr. Black has been a member of the Canadian Electrical Association since its inception, and has been most of the time on its executive committee. He is the local electrical inspector for the Canadian Fire Underwriters.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Toronto Junction, writes: Would like some information as to where I might obtain a book treating on the design and construction of water turbines; also what kind of machine is used to produce Faradic currents, such as are used for electrical treatment by doctors. Is there any book published on the design of such a machine?

ANSWER.—(1) There are several books treating on turbines, which can be seen in the Public Library, one of the best being Professor Rankin's. (2) Electricity in Electro Therapeutics, by Houston & Kennelly, price about \$1.50, would probably answer your requirements.

BUSINESS MAXIMS FOR ELECTRICAL COMPANIES.

An electrical company in Buffalo has compiled these "Electrical Don'ts." Some good advice is tersely expressed.

Don't try to revolutionize the electrical business by cutting prices. You can't.

Don't expect to get all the jobs you figure on, and get mad if you don't.

Don't expect to make a living on a 10 per cent. margin of profit. You can't.

Don't abuse your competitor because he underbid you. He may lose money and yet do as good work as you.

Don't bid low, do poor work and employ boys to even up. You can't.

Don't educate the embryo electrician and then try to kill him off as soon as he is able to work.

Don't give your work away. What is worth doing is worth getting paid for; and, above all, employ good workmen.

THE NATIONAL ELECTRICAL CODE.

AFTER many months of labor and careful consideration, an electrical code has finally been adopted by the National Board of Fire Underwriters of the United States. The code is identical with that which received the unanimous approval of the Code Committee of the National Conference on Standard Electrical Rules, and is the result of the united efforts of the various electrical, insurance, architectural and allied associations, which have recommended its adoption. These rules received the approval of the National Electric Light Association at its meeting at Niagara Falls in June last, and now, for the first time, a National Electrical Code is issued, stamped with the approval of the insurance as well as the electrical and allied interests. The matter has, we believe, sufficient interest for our readers to warrant the publication of the code:

The following associations have unanimously voted to recommend the code to their respective associations for approval and adoption: American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, Underwriters' National Electric Association.

GENERAL PLAN GOVERNING THE ARRANGEMENT OF RULES.

Class A.—Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, etc. Rules 1 to 11.

Class B.—Outside Work, all systems and voltages. Rules 12 and 13.

Class C.—Inside work. Rules 14 to 39. Sub-divided as follows: General Rules, applying to all systems and voltages. Rules 14 to 17.

Constant-Current Systems. Rules 18 to 20.

Constant-Potential Systems. All voltages: Rules 21 to 23. Voltage not over 300: Rules 24 to 31. Voltage between 300 and 3,000: Rules 32 to 37. Voltage over 3,000: Rules 38 to 39.

Class D.—Specifications for Wires and Fittings. Rules 40 to 55.

Class E.—Miscellaneous. Rules 56 to 59.

Class F.—Marine Wiring. Rules 60 to 72.

GENERAL SUGGESTIONS.

In all electric work, conductors, however well insulated, should always be treated as bare, to the end that under no conditions, existing or likely to exist, can a grounding or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum.

In all wiring special attention must be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, tapping of conductors and securing and attaching of fittings, are specially conducive to security and efficiency, and will be strongly insisted on.

In laying out an installation, except for constant-current systems, the work should, if possible, be started from a centre of distribution, and the switches and cut-outs, controlling and connected with the several branches, be grouped together in a safe and easily accessible place, where they can be readily got at for attention or repairs. The load should be divided as evenly as possible among the branches, and all complicated and unnecessary wiring avoided.

The use of wire-ways for rendering concealed wiring permanently accessible is most heartily endorsed and recommended; and this method of accessible concealed construction is advised for general use.

Architects are urged, when drawing plans and specifications, to make provision for the channeling and pocketing of buildings for electric light or power wires, and in specifications for electric gas lighting to require a two-wire circuit, whether the building is to be wired for electric lighting or not, so that no part of the gas fixtures or gas piping be allowed to be used for the gas lighting circuit.

CLASS A.—STATIONS AND DYNAMO ROOMS.

Includes Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, Etc.

1. GENERATORS—

- a. Must be located in a dry place.

- b. Must never be placed in a room where any hazardous process is carried on, nor in places where they would be exposed to inflammable gases or flyings of combustible materials.

- c. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry. Where frame insulation is impracticable, the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

- d. A high-potential machine which, on account of great weight or for other reasons, cannot have its frame insulated from the ground, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must always stand upon it in order to touch any part of the machine.

- e. In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected with the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

- f. Every constant-potential generator must be protected from excessive current by a safety fuse, or equivalent device, of approved design in each lead wire.

- g. These devices should be placed on the machine or as near it as possible.

- h. Where the needs of the service make these devices impracticable, the Inspection Department having jurisdiction may, in writing, modify the requirements.

- i. Must each be provided with a waterproof cover.

- j. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes, and normal speed in revolutions per minute.

2. CONDUCTORS—

From generators to switch-boards, rheostats or other instruments, and thence to outside lines.

- a. Must be in plain sight or readily accessible.

- b. Must have an approved insulating covering as called for by rules in Class "C" for similar work, except that in central stations, on exposed circuits, the wire which is used must have a heavy braided non-combustible outer covering.

Bus bars may be made of bare metal.

- c. Must be kept so rigidly in place that they cannot come in contact.

- d. Must in all other respects be installed under the same precautions as required by rules in Class "C" for wires carrying a current of the same volume and potential.

3. SWITCHBOARDS—

- a. Must be so placed as to reduce to a minimum the danger of communicating fire to adjacent combustible material.

Special attention is called to the fact that switchboards should not be built down to the floor, nor up to the ceiling, but a space of at least ten or twelve inches should be left between the floor and the board, and from eighteen to twenty-four inches between the ceiling and the board, in order to prevent fire from communicating from the switchboard to the floor or ceiling, and also to prevent the forming of a partially concealed space very liable to be used for storage of rubbish and oily waste.

- b. Must be made of non-combustible material or of hardwood in skeleton form, filled to prevent absorption or moisture.

- c. Must be accessible from all sides when the connections are on the back, but may be placed against a brick or stone wall when the wiring is entirely on the face.

- d. Must be kept free from moisture.

- e. Bus bars must be equipped in accordance with rules for placing conductors.

4. RESISTANCE BOXES AND EQUALIZERS—(For construction rules see No. 52.)

- a. Must be placed on a switchboard, or, if not thereon, at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive insulating material.

5. LIGHTNING ARRESTERS—(For construction rules see No. 55.)

- a. Must be attached to each side of every overhead circuit connected with the station.

It is recommended to all electric light and power companies that arresters be connected at intervals over systems in such numbers and so located as to prevent ordinary discharges entering (over the wires) buildings connected to the lines.

- b. Must be located in readily accessible places away from combustible materials, and as near as practicable to the point where the wires enter the building.

Station arresters should generally be placed in plain sight on the switchboard.

In all cases, kinks, coils and sharp bends in the wires between

the arresters and the out-door lines must be avoided as far as possible.

c. Must be connected with a thoroughly good and permanent ground connection by metallic strips or wires having a conductivity not less than that of a No. 6 B. & S. copper wire, which must be run as nearly in a straight line as possible from the arresters to the earth connection.

Ground wires for lightning arresters must not be attached to gas pipes within the buildings.

It is often desirable to introduce a choke coil in circuit between the arresters and the dynamo. In no case should the ground wire from a lightning arrester be put into iron pipes, as these would tend to impede the discharge.

6. CARE AND ATTENDANCE—

a. A competent man must be kept on duty where generators are operating.

b. Only waste must be kept in approved metal cans and removed daily.

Approved waste cans shall be made of metal, with legs raising can three inches from the floor, and with self-closing covers.

7. TESTING OF INSULATION RESISTANCE—

a. All circuits must be provided with reliable ground detectors. Detectors which indicate continuously, and give an instant and permanent indication of a ground, are preferable. Ground wires from detectors must not be attached to gas-pipes within the building.

b. Where continuously indicating detectors are not feasible, the circuits should be tested at least once per day, and preferably oftener.

c. Data obtained from all tests must be preserved for examination by the Inspection Department having jurisdiction.

These rules on testing to be applied at such places as may be designated by the Inspection Department having jurisdiction.

8. MOTORS—

a. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture; and must be kept clean and dry. Where frame insulation is impracticable the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high potential machine which, on account of great weights or for other reasons, cannot have its frame insulated, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected to the earth, or by grounding the frame through a very high resistance or not less than 200 ohms per volt generated by the machine.

b. Must be wired under the same precautions as required by rules in Class "C", for wires carrying a current of the same volume and potential.

The leads or branch circuits should be designed to carry a current at least fifty per cent. greater than that required by the rated capacity of the motor to provide for the inevitable over-loading of the motor at times without over-fusing the wires.

c. The motor and resistance box must be protected by a cut-out and controlled by a switch (see No. 170) said switch plainly indicating whether "on" or "off". Where one-quarter horsepower or less is used on low tension circuits a single pole switch will be accepted. The switch and rheostat must be located within sight of the motor, except in such cases where special permission to locate them elsewhere is given, in writing, by the Inspection Department having jurisdiction.

d. Must have their rheostats or starting boxes located so as to conform to the requirements of Rule 4.

In connection with motors the use of circuit breakers, automatic starting boxes and automatic under-load switches is recommended, and they must be used when required.

e. Must not be run in series-multiple or multiple-series.

f. Must be covered with a water-proof cover when not in use, and if deemed necessary by the Inspection Department having jurisdiction, must be enclosed in an approved case.

From the nature of the question the decision as to what is an approved case must be left to the Inspection Department having jurisdiction to determine in each instance.

g. Must, when combined with ceiling fans, be hung from insulated hooks, or else there must be an insulator interposed between the motor and its support.

h. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

9. RAILWAY POWER PLANTS—

a. Must be equipped in each feed wire before they leave the station with an approved automatic circuit breaker (see No. 44) or other device, which will immediately cut off the current in case of a ground. This device must be mounted on a fireproof base, and in full view and reach of the attendant.

10. STORAGE OR PRIMARY BATTERIES

a. When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as applied to similar apparatus fed from dynamo generators developing the same difference of potential.

b. Storage battery rooms must be thoroughly ventilated.

c. Special attention is directed to the rules for rooms where acid fumes exist. (See No. 24, j and k.)

d. All secondary batteries must be mounted on non-absorptive, non-combustible insulators, such as glass or thoroughly vitrified and glazed porcelain.

e. The use of any metal liable to corrosion must be avoided in connections of secondary batteries.

11. TRANSFORMERS—(For construction rules see No. 34.)

a. In central or sub-stations the transformers must be so placed that smoke from the burning out of the coils or the boiling over of the oil (where oil filled cases are used) could do no harm.

CLASS B.—OUTSIDE WORK.

All Systems and Voltages.

12. WIRES—

a. Service wires must have an approved rubber insulating covering. (See No. 40a.) Line wires, other than services, must have an approved weather-proof, or rubber insulating covering. (See No. 40 a and b.) All tie wires must have an insulation equal to that of the conductors they confine.

b. Must be so placed that moisture can not form a cross connection between them not less than a foot apart, and not in contact with any substance other than their insulating supports. Service blocks must be covered over their entire surface with at least two coats of waterproof paint.

c. Must be at least seven feet above the highest point of flat roofs, and at least one foot above the ridge of pitched roofs over which they passed or to which they are attached.

d. Must be protected by dead insulated guard iron or wires from possibility of contact with other conducting wires or substances to which current may leak. Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

e. Must be provided with petticoat insulators of glass or porcelain. Porcelain knobs or cleats and rubber hooks will not be approved.

f. Must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

g. Must, where they enter buildings, have drip loops outside, and the holes through which the conductors pass must be bushed with non-combustible, non-absorptive insulating tubes slanting upward toward the inside.

h. Telegraph, telephone and similar wires must not be placed on the same cross-arm with electric light or power wires.

i. The metallic sheathes to cables must be permanently and effectively connected to "earth".

TROLLEY WIRES.

j. Must not be smaller than No. 6 B. & S. copper or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

k. Must have a double insulation from the ground. In wooden pole construction, the pole will be considered as one insulation.

l. Must be capable of being disconnected at the power plant, or of being divided into sections, so that, in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen. This rule also applies to feeders.

m. Must be safely protected against accidental contact where crossed by other conductors.

Guard wires should be insulated from the ground and should be electrically disconnected in sections of not more than 300 feet in length.

GROUND RETURN WIRES.

n. For the diminution of electrolytic corrosion of underground metal work, ground return wires must be so arranged that the difference of potential between the grounded dynamo terminal and any point on the return circuit will not exceed twenty-five volts.

It is suggested that the positive pole of the dynamo be connected to the trolley line, and that whenever pipes or other underground metal work are found to be electrically positive to the rails or surrounding earth, that they be connected by conductors arranged so as to prevent as far as possible current flow from the pipes into the ground.

13. TRANSFORMERS.—(For construction rules see No. 54.)

a. Must not be placed inside of any building, excepting central stations, unless by special permission of the Inspection Department having jurisdiction.

b. Must not be attached to the outside walls of buildings, unless separated therefrom by substantial supports.

CLASS C. INSIDE WORK.

All Systems and Voltages.

GENERAL RULES. ALL SYSTEMS AND VOLTAGES.

14. WIRES.—(For special rules see Nos. 18, 24, 32, 38 and 39.)

a. Must not be of smaller size than No. 14 B. & S., except as allowed under rules 24u and 40c.

b. Tie wires must have an insulation equal to that of the conductors they confine.

c. Must be so spliced or joined as to be both mechanically and electrically secure without solder; they must then be soldered to insure preservation, and the joint covered with an insulation equal to that on the conductors.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

d. Must be separated from contact with walls, floors, timbers or partitions through which they may pass by non-combustible, non-absorptive insulating tubes, such as glass or porcelain.

Bushings must be long enough to bush the entire length of the hole in one continuous piece, or else the hole must first be bushed by a continuous water-proof tube, which may be a conductor, such as iron pipe; the tube then is to have a non-conducting bushing pushed in at each end so as to keep the wire absolutely out of contact with the conducting pipe.

e. Must be kept free from contact with gas, water of other metallic piping, or any other conductors or conducting material which they may cross, by some continuous and firmly fixed non-conductor, creating a separation of at least one inch. Deviations from this rule may sometimes be allowed by special permission.

f. Must be so placed in wet places that an air space will be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run over, rather than under, pipes upon which moisture is likely to gather or which, by leaking, might cause trouble on a circuit.

15. UNDERGROUND CONDUCTORS.—

a. Must be protected, when brought into a building, against moisture and mechanical injury, and all combustible material must be kept removed from the immediate vicinity.

b. Must not be so arranged as to shunt the current through a building around any catch-box.

16. TABLE OF CARRYING CAPACITY OF WIRES.—

Below is a table showing the allowable carrying capacity of wires containing ninety-eight per cent. pure copper, which must be followed in placing interior conductors:

TABLE A. Rulder Covered Wires, See No. 4 a.		TABLE B. Weather-proof Wires, See No. 4 b.	
B. & S. G.	Ampères.		Ampères.
18	3	18	5
16	6	16	8
14	12	14	16
12	17	12	23
10	24	10	32
8	33	8	46
6	40	6	65
5	51	5	77
4	65	4	92
3	76	3	110
2	90	2	131
1	107	1	156
0	127	0	185
00	150	00	220
000	177	000	262
0000	210	0000	312

Circular Mills.	Ampères.	Ampères.
200,000	200	300
300,000	270	400
400,000	330	500
500,000	390	590
600,000	450	680
700,000	500	760
800,000	550	840
900,000	600	920
1,000,000	650	1,000
1,100,000	690	1,080
1,200,000	730	1,150
1,300,000	770	1,220
1,400,000	810	1,290
1,500,000	850	1,360
1,600,000	890	1,430
1,700,000	930	1,490
1,800,000	970	1,550
1,900,000	1,010	1,610
2,000,000	1,050	1,670

The lower limit is specified for rubber-covered wires to prevent gradual deterioration of the high insulations by the heat of the wires, but not from fear of igniting the insulation. The question of drop is not taken into consideration in the above tables.

The carrying capacity of sixteen and eighteen wire is given, but no smaller than fourteen is to be used, except as allowed under Rules 24u and 40c.

17. SWITCHES, CUT-OUTS, CIRCUIT BREAKERS, ETC.—(For construction rules, see Nos. 43, 44 and 45.)

a. Must, whenever called for, unless otherwise provided (for exceptions, see No. 8c and No. 22c), be so arranged that the cut-outs will protect, and the opening of the switch or circuit breaker will disconnect, all of the wires; that is, in a two-wire system the two wires, and in a three-wire system the three wires, must be protected by the cut-out and disconnected by the operation of the switch or circuit breaker.

b. Must not be placed in the immediate vicinity of easily ignitable stuff or where exposed to inflammable gases or dust or to flyings of combustible material.

c. Must, when exposed to dampness, either be inclosed in a waterproof box or mounted on porcelain knobs.

CONSTANT CURRENT SYSTEMS.

Principally Series Arc Lighting.

18. WIRES.—(See also No. 14, 15 and 16.)

a. Must have an approved rubber insulating covering. (See No. 40a.)

b. Must be arranged to enter and leave the building through an approved double-contact service switch (see No. 43.) mounted in a non-combustible case, kept free from moisture, and easy of access to police or firemen. So-called "snap switches" must not be used on high potential circuits.

c. Must always be in plain sight, and never incased, except when required by the Inspection Department having jurisdiction.

d. Must be supported on glass or porcelain insulators, which separate the wire at least one inch from the surface wired over, and must be kept rigidly at least eight inches from each other, except within the structure of lamps, on hanger-boards, in cut-out boxes, or like places, where a less distance is necessary.

e. Must, on side walls, be protected from mechanical injury by a substantial boxing, retaining an air space of once inch around the conductors, closed at the top (the wires passing through bushed holes), and extending not less than seven feet from the floor. When crossing floor-timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

19. ARC LAMPS.—(For construction rules, see No. 49.)

a. Must be carefully isolated from inflammable material.

b. Must be provided at all times with a glass globe surrounding the arc, securely fastened upon a close base. No broken or cracked globes are to be used.

c. Must be provided with a wire netting (having a mesh not exceeding one and one-quarter inches) around the globe, and an approved spark arrester (see No. 50), when readily inflammable material is in the vicinity of the lamps, to prevent escape of sparks, melted copper or carbon. It is recommended that plain carbons, not copper-plated, be used for lamps in such places.

Are lamps, when used in places where they are exposed to flyings of easily inflammable material, should have the carbons inclosed completely in a globe in such manner as to avoid the necessity for spark arresters.

For the present, globes and spark arresters will not be required on so-called "inverted arc" lamps, but this type of lamp must not be used where exposed to flyings of easily inflammable materials.

d. Where hanger-boards (see No. 48) are not used, lamps must be hung from insulating supports other than their conductors.

20. INCANDESCENT LAMPS IN SERIES CIRCUITS.

a. Must have the conductors installed as provided in Rule No. 18, and each lamp must be provided with an automatic cut-out.

b. Must have each lamp suspended from a hanger-board by means of rigid tube.

c. No electro-magnetic device for switches and no system of multiple-series or series-multiple lighting will be approved.

d. Under no circumstances can they be attached to gas fixtures.

CONTINANT-POTENTIAL SYSTEMS.

General Rules.—All Voltages.

21. AUTOMATIC CUT-OUTS (Fuses and Circuit Breakers.) (See No. 17, and for construction, Nos. 44 and 45.)

a. Must be placed on all service wires, either overhead or underground, as near as possible to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building.

Where the switch required by Rule No. 22 is inside the building, the cut-out required by this section must be placed so as to protect it.

b. Must be placed at every point where a change is made in the size of wire [unless the cut-out in the larger wire will protect the smaller. (See No. 16)].

c. Must be in plain sight, or enclosed in an approved box (see No. 46), and readily accessible. They must not be placed in the canopies or shells of fixtures.

d. Must be so placed that no set of incandescent lamps, whether grouped or one fixture or several fixtures or pendants, requiring a current of more than six amperes, shall be dependent upon one cut-out. Special permission may be given in writing by the Inspection Department having jurisdiction for departure from this rule in cases of large chandeliers.

e. Must be provided with fuses, the rated capacity of which does not exceed the allowable carrying capacity of the wire, and when circuit breakers are used, they must not be set more than about thirty per cent. above the allowable carrying capacity of the wire, unless a fusible cut-out is also installed in the circuit (see No. 16).

22. SWITCHES.—(See No. 17, and for construction, No. 43.)

a. Must be placed on all service wires, either overhead or underground, in a readily accessible place, as near as possible to the point where the wires enter the building, and arranged to cut off the entire current.

b. Must always be placed in dry, accessible places, and be grouped as far as possible. Knife switches must be so placed that gravity will tend to open rather than close the switch.

c. Must not be single-pole, except when the circuits which they control supply not more than six sixteen candle-power lamps or their equivalent.

d. Where gangs of flush switches are used, whether with conduit systems or not, the switches must be inclosed in boxes constructed of or lined with fire resisting material. Where two or more switches are placed under one plate, the box must have a separate compartment for each switch. No push buttons for bells, gas lighting circuits or the like shall be placed in the same wall plate with switches controlling electric light or power wiring.

23. ELECTRIC HEATERS.—

a. Must, if stationary, be placed in a safe situation, isolated from inflammable materials and be treated as sources of heat.

b. Must each have a cut-out and indicating switch (see No. 17a).

c. Must have the attachments of feed wires to the heaters in plain sight, easily accessible and protected from interference, accidental or otherwise.

d. The flexible conductors for portable apparatus, such as irons, etc., must have an approved insulating covering (see No. 40c, 3).

e. Must each be provided with name-plate, giving the maker's name and the normal capacity in volts and amperes.

LOW POTENTIAL SYSTEMS.—300 Volts or Less.

Any circuit attached to any machine, or combination of machines, which develops a difference of potential between any two wires of over ten volts and less than 300 volts, shall be considered as a low potential circuit, and as coming under the class, unless an approved transforming device is used, which cuts the difference of potential down to ten volts or less. The primary circuit not to exceed a potential of 3,000 volts.

24. WIRES. General Rules. (See also Nos. 14, 15 and 16.)

a. Must not be laid in plaster, cement or similar finish.

b. Must never be fastened with staples.

c. Must not be fished for any great distance, and only in places where the inspector can satisfy himself that the rules have been complied with.

d. Twin wires must never be used, except in conduits, or where flexible conductors are necessary.

e. Must be protected on side walls from mechanical injury. When crossing floor timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip, not less than one-half inch in thickness, and not less than three inches in width.

Suitable protection on side walls may be secured by a substantial boxing, retaining an air space of one inch around the conductor, closed at the top (the wires passing through bushed holes), and extending not less than five feet from the floor; or by an iron-armored or metal-sheathed insulating conduit sufficiently strong to withstand the strain it will be subjected to; or plain metal pipe, lined with insulating tubing which must extend one-half inch beyond the end of the metal tube.

The pipe must extend not less than five feet above the floor, and may extend through the floor in place of a floor bushing.

If iron pipes are used with alternating currents, the two or more wires of a circuit must be placed in the same conduit. In this case the insulation of each wire must be reinforced by a tough conduit tubing projecting beyond the ends of the iron pipe at least two inches.

f. When run immediately under roofs, or in proximity to water tanks or pipes, will be considered as exposed to moisture.

SPECIAL RULES.

For open work, in dry places:

g. Must have an approved rubber or weather-proof insulation. (See No. 40a and b.)

h. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one-half inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches, and run from timber to timber, not breaking around, and may be supported at each timber only.

This rule will not be interpreted to forbid the placing of the neutral of a three-wire system in the centre of a three-wire cleat, provided the outside wires are separated two and one-half inches.

In damp places, such as breweries, packing houses, stables, dye houses, paper or pulp mills, or buildings specially liable to moisture or acid or other fumes liable to injure the wires or their insulation, except where used for pend units:

i. Must have an approved rubber insulating covering (see No. 40a).

j. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring over flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches and run from timber to timber, not breaking around, and may be supported at each timber only.

k. Must have no joints or splices.

For moulding work:

l. Must have approved rubber insulating covering (see No. 40a).

m. Must never be placed in moulding in concealed or damp places.

For conduit work:

n. Must have an approved rubber insulating covering (see No. 40c).

The use of concentric wire (see No. 40c) is recommended in preference to twin conductors.

o. Must not be drawn in until all mechanical work on the building has been, as far as possible, completed.

p. Must not have wires of different circuits drawn in the same conduit.

q. Must, for alternating systems, have the two or more wires of a circuit drawn in the same conduit.

It is advised that this be done for direct-current system also, so that they may be changed to alternating systems at any time, induction troubles preventing such a change unless this construction is followed.

For so-called concealed work:

- r. Must have an approved rubber insulating covering (see No. 40a).
- s. Must be rigidly supported on non-combustible, non-absorptive insulators which separate the wire at least one inch from the surface wired over, and must be kept at least ten inches apart, and, when possible, should be run singly on separate timbers or studding.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened.

- t. When from the nature of the case it is impossible to place concealed wiring on non-combustible insulating supports of glass or porcelain, the wires, if not exposed to moisture, may be fished on the loop system if encased throughout in approved continuous flexible tubing or conduit.

For fixture work:

- u. Must have an approved rubber insulating covering (see No. 40d), and shall not be less in size than No. 18 B. & S.

v. Supply conductors, and especially the splices to fixture wires, must be kept clear of the grounded part of gas pipes, and, where shells are used, the latter must be constructed in a manner affording sufficient area to allow this requirement.

- w. Must, when fixtures are wired outside, be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixture.

25. INTERIOR CONDUITS—(See also Nos. 24n to q, and 41).

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors to protect them from mechanical injury and, as far as possible, from moisture. Tubes or conduits are to be considered merely as raceways, and are not to be relied upon for insulation between wire and wire, or between the wire and the ground.

- a. Must be continuous from one junction box to another or to fixtures, and the conduit tube must properly enter all fittings.

b. Must be first installed as a complete conduit system, without the conductors.

c. Conduits must extend at least one-half inch beyond the finished surface of walls or ceilings, except that, if the end is threaded and a coupling screwed on, the conduit may be left flush with the surface, and the coupling may be removed when work on building is completed.

d. Must, after conductors are introduced, have all outlets plugged with special wood or fibrous plugs, made in parts, and the outlet then sealed with approved compound. Joints must be made air-tight and moisture-proof.

- e. Must have the metal of the conduit permanently and effectually grounded.

26. FIXTURES—(See also No. 24n to w.)

a. Must, when supported from the gas piping of a building, be insulated from the gas-pipe system by means of approved insulating joints (see No. 51) placed as close as possible to the ceiling.

It is recommended that the gas outlet pipe be protected above the insulating joint by a non-combustible, non-absorptive insulating tube, having a flange at the lower end where it comes in contact with the insulating joint; and that, where outlet tubes are used, they be of sufficient length to extend below the insulating joint, and that they be so secured that they will not be pushed back when the canopy is put in place. Where iron ceilings are used, care must be taken to see that the canopy is thoroughly and permanently insulated from the ceiling.

b. Must have all bars, or fins, removed before the conductors are drawn into the fixture.

c. The tendency to condensation within the pipes should be guarded against by sealing the upper end of the fixture.

d. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

e. Must be tested for "contacts" between conductors and fixtures, for "short circuits" and for ground connections before it is connected to its supply conductors.

f. Ceiling blocks of fixtures should be made of insulating material; if not, the wires in passing through the plate must be surrounded with non-combustible, non-absorptive, insulating material, such as glass or porcelain.

27. SOCKETS—(For construction rules, see No. 47.)

a. In rooms where inflammable gases may exist the incandescent lamp and socket must be enclosed in a vapor-tight globe, and supported on a pipe-hanger, wired with approved rubber-covered wire (see No. 40a) soldered directly to the circuit.

b. In damp or wet places, or over specially inflammable stuff, waterproof sockets must be used.

When waterproof sockets are used, they should be hung by separate stranded rubber-covered wires, not smaller than No. 14 B. & S., which should preferably be twisted together when the drop is over three feet. These wires should be soldered direct to the circuit wires, but supported independently of them.

28. FLEXIBLE CORD—

- a. Must have an approved insulation and covering (see No. 40c.)
- b. Must not be used as a support for clusters.
- c. Must not be used except for pendants, wiring of fixtures and portable lamps or motors.
- d. Must not be used in show windows.
- e. Must be protected by insulating bushings where the cord enters the socket.

f. Must be so suspended that the entire weight of the socket and lamp will be borne by knots under the bushing in the socket, and above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws.

29. ARC LIGHTS ON LOW-POTENTIAL CIRCUITS—

- a. Must have a cut-out (see No. 17a) for each lamp or each series of lamps.

The branch conductors should have a carrying capacity about fifty per cent. in excess of the normal current required by the lamp to provide for heavy current required when lamp is started or when carbons become stuck without over-fusing the wires.

b. Must only be furnished with such resistances or regulators as are inclosed in non-combustible material, such resistances being treated as sources of heat. Incandescent lamps must not be used for resistance devices.

c. Must be supplied with globes and protected by spark arrestors and wire netting around globe, as in the case of arc lights on high-potential circuits. (See Nos. 19 and 50.)

30. ECONOMY COILS—

a. Economy and compensator coils for arc lamps must be mounted on non-combustible, non-absorptive insulating supports, such as glass or porcelain, allowing an air space of at least one inch between frame and support, and in general to be treated like sources of heat.

31. DECORATIVE SERIES LAMPS—

a. Incandescent lamps run in series shall not be used for decorative purpose inside of buildings, except by special permission in writing from the Inspection Department having jurisdiction.

HIGH-POTENTIAL SYSTEMS.

300 to 3,000 Volts.

Any circuit attached to any machine, or combination of machine, which develops a difference of potential, between any two wires, of over 300 volts and less than 3,000 volts, shall be considered as a high-potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference or potential down to 300 volts or less.

32. WIRES—(See also Nos. 14, 15 and 16.)

a. Must have an approved rubber insulating covering. (See No. 40a.)

b. Must be always in plain sight and never incased, except where required by the Inspection Department having jurisdiction.

c. Must be rigidly supported on glass or porcelain insulators, which raise the wire at least one inch from the surface wired over, and must be kept apart at least four inches for voltages up to 750 and at least eight inches for voltages over 750.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least about every four and one-half feet.

If the wires are unusually liable to be disturbed, the distance between supports should be shortened.

In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about six inches for voltages up to 750 and about ten inches for voltages above 750; and run from timber to timber, not breaking around, and may be supported at each timber only.

d. Must be protected on side walls from mechanical injury by a substantial boxing retaining an air space of one inch around the conductors, closed at the top (the wires passing through bushed holes) and extending not less than seven feet from the floor. When crossing floor timbers, in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

33. TRANSFORMERS (When permitted inside buildings, see No. 13)—(For construction rules, see No. 54.)

a. Must be located at a point as near as possible to that at which the primary wires enter the building.

b. Must be placed in an inclosure constructed of or lined with fire-resisting material; the inclosure to be used only for this purpose, and to be kept securely locked and access to the same allowed only to responsible persons.

c. Must be effectually insulated from the ground and the inclosure in which they are placed must be practically air-tight, except that it shall be thoroughly ventilated to the outdoor air, if possible, through a chimney or flue. There should be at least six inches air space on all sides of the transformer.

34. CAR WIRING—

a. Must be always run out of reach of the passengers, and must have an approved rubber insulating covering. (See No. 40a.)

35. CAR HOUSES—

a. Must have the trolley wires securely supported on insulating hangers.

b. Must have the trolley hangers placed at such a distance apart that, in case of a break in the trolley wire, contact can not be made with the floor.

c. Must have cut-out switch located at a proper place outside of the building, so that all trolley circuits in the building can be cut out at one point, and line circuit breakers must be installed, so that when this cut-out switch is open the trolley wire will be dead at all points within 100 feet of the building. The current must be cut out of the building whenever the same is not in use or the road not in operation.

d. Must have all lamps and stationary motors installed in such a way that one main switch can control the whole of each installation—lighting or power—independently of main feeder-switch. No portable incandescent lamps or twin wire allowed, except that portable incandescent lamps may be used in the pits, connections to be made by two approved rubber-covered flexible wires (see No. 40a), properly protected against mechanical injury; the circuit to be controlled by a switch placed outside of the pit.

e. Must have all wiring and apparatus installed in accordance with rules under Class "C" for constant potential systems.

f. Must not have any system of feeder distribution centering in the building.

g. Must have the rails bonded at each point with not less than No. 2 B. & S. annealed copper wire; also a supplementary wire to be run for each track.

h. Must not have cars left with trolley in electrical connection with the trolley wire.

36. LIGHTING AND POWER FROM RAILWAY WIRES—

a. Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, except in electric railway cars, electric car houses, and their power stations, nor shall the same dynamo be used for both purposes.

37. SERIES LAMPS—

a. No system of multiple-series or series-multiple for light or power will be approved.

b. Under no circumstances can lamps be attached to gas fixtures.

EXTRA HIGH-POTENTIAL SYSTEMS.

Over 3,000 Volts.

Any circuit attached to any machine or combination of machines, which develops a difference of potential, between any two wires, of over 3,000 volts, shall be considered as an extra high potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 3,000 volts or less.

38. PRIMARY WIRES—

Must not be brought into or over buildings, except power and substations.

39. SECONDARY WIRES—

a. Must be installed under rules for high-potential systems, when their immediate primary wires carry a current at a potential of over 3,000 volts.

The high line insulation required for extra high-potential current tends to make the insulation resistance between primary and secondary coils of transformers a comparatively weak point, and lightning discharges would be apt to take this path to the earth. With the present means of protection against transformer break-downs and the consequent liability of secondary wiring being subjected to the strain of the primary current, it is not deemed advisable to permit a primary current with a potential of over 3,000 volts without an intermediate step-down transformer. The presence of wires carrying a current at a potential of over 3,000 volts in the streets of cities and towns is also considered as increasing the fire hazard.

(To Be Continued.)

The New York and New Haven Railway Company recently adopted what is known as the third rail system on a branch line of railway thirteen miles long. The electric power for the motors is carried along the track by a special rail laid between the two, on which the cars run. The "electrified" rail weighs 100 pounds to the yard, and is shaped like a wedge, with a flat top. This affords a large conductive body, with plenty of surface for the "shoes" which convey the current to the motors to act upon. Insulation is provided by simple blocks of wood, which, to the surprise of the experts, have been found to answer perfectly well, the loss of current being practically insignificant. At crossings, switches and stations the current is conducted underground, while an ingenious automatic arrangement, operated by electricity, provides compressed air to operate a whistle for signalling.

SPARKS.

Mr. E. B. Tree, of Woodstock, Ont., has invented a rotary engine.

William Davidson is supplying two 50-horse power boilers for the Exhibition Association of Halifax, N.S.

The Exeter Electric Light and Power Company has been organized at Exeter, Ont., with a capital of \$10,000. The provisional board is composed of C. Lutz, president; R. C. C. Tremaine, B. A. Se., manager; B. S. O'Neill, E. J. Spackman and Frank Woods.

The Gas and Water Company, of Sherbrooke, Que., have reduced the price of electric lighting from \$1 per 100 lamp-hours to 75 cents, with a further reduction of 15 cents on payment within 15 days. This is practically 60 cents for a 10-candle power lamp burning 100 hours.

The New York post office is laying underground postal tubes this summer for distribution of letters. The tubes will be eight inches in diameter, and carriers capable of containing 500 letters each will be forced through them by power furnished by an electric plant in the General Postoffice.

The Canadian Locomotive and Engine Company, of Kingston, Ont., are now making steel pipes under patents held by Mr. F. A. Williams, of Wolverton, England. Tests of the pipes were recently made in the presence of a number of experts, and are said to have been entirely satisfactory.

The Dominion Electric Heating and Supply Company, of Ottawa, have elected the following officers: President, Andrew Holland; vice-president, Thomas Askwith; secretary-treasurer, J. I. McCracken; directors, Chas. A. Carriere, A. Trudeau, P. MacGregor, Geo. Low and B. H. Bell.

A syndicate of capitalists are said to be negotiating for the purchase of the Chemung and Lakefield lines of the Grand Trunk Railway, with a view of converting them into electric systems. For the present the scheme is kept somewhat in the dark, but definite information is looked for at an early date.

The Lachine Rapids Hydraulic and Land Company, of Montreal, have made a reduction of 33 1/3 per cent. in the rate charged for electric power. This brings the price to one-half cent per 16 candle-power lamp per hour, and is claimed to be the cheapest rates charged in any city the size of Montreal in the world. The company have lately issued \$500,000 of six per cent. debentures, redeemable in ten years. These were issued among the stockholders only, each of whom were allowed to take debentures to the amount of 50 per cent. of the stock held.

The Dominion Government has completed forty miles more of the telegraph line on the north shore of the St. Lawrence, from the former terminus at Pointe Esquimaux, and an office has been opened at Plastré Bay. It is intended to extend the line forty-four miles more this summer, to Natashquan, where an office will be opened this fall. The north shore line will still be about 250 miles from Belle Isle, its objective point, and it is the intention to complete this section as rapidly as possible, so that the entrance to the Straits of Belle Isle will be in direct telegraphic communication with Quebec and Montreal.

A car "fender," the design of the manager, Mr. J. W. Moyes, has been adopted by the Metropolitan Street Railway. The fender, which is 5 feet 8 inches by 2 feet 6 inches, and lies without rocking about three inches above the rails, hangs on two perpendicular strings, instead of horizontal ones, and its braces are attached to the main body of the car. There is consequently no recoil, and whatever the fender picks up it holds, as was demonstrated when the car ran at a considerable speed into a flock of sheep, coming in the opposite direction. A point in its favor is that it can be folded up while on the car, to the saving of much valuable room in a motor shed.

A sextuplex telegraph wire was successfully operated in a telegraph office in Boston a few days ago. The circuit was to New Haven and return, a distance of 300 miles. Three different messages were sent over the wire simultaneously, and were easily and accurately received on the receiving side. The inventor of the new scheme is Mr. Thomas B. Dixon, of Kentucky, son of the late former Senator Archibald Dixon, of that state. He is a practical telegrapher, and has been trying to solve the problem of the sextuplex since 1861. The telegraphic world has long been familiar with a duplex wire, which will transmit one message each way at the same time, and latter with the quadruplex, with which it is possible to send two messages each way at the same time. The new sextuplex will transmit three messages each way at once.

WATER HAMMER.

A DESCRIPTION of some experiments upon the causes of steam pipe explosions, made to an engineering society, shows under what conditions water hammer may be expected in steam pipes and under what conditions it becomes dangerous. The tests were made upon steam pipes 6" in diameter and .197" thick. The ends were closed by flanges and provided with drain cocks and air relief-cocks, and suitable pressure gauges that would record to 2133 pounds, one on the end flange and one on the top of the pipe. The pipe was inclined upward, and entering the bottom flange was a steam pipe with a valve, so that if any water was in the pipe the entering steam must pass through it.

The second experiment was conducted upon 12" pipe, 1/4" thick, with four pressure gauges, steam being supplied at the bottom through a 3" pipe. The position of this pipe was afterwards considerably changed. The tests made were as follows:

1. Pipe without water, air cock closed and the drain cock open.
2. Pipe without water, air cock open and the drain cock closed.
3. Pipe without water, air and drain cocks open.
4. Pipe without water, air and drain cocks closed.
5. Vacuum in pipe and some condensed water formed by creating vacuum, air and drain cocks closed.
6. Vacuum in pipe, and the latter filled with water to about one-third of its cubic capacity, so that the point where the steam entered was under water in the first pipe, it being made to incline toward that point. In the second pipe the water filled the bottom of the pipe. Air and drain cocks were closed to one-third of their capacity at one end, and running into nothing at the other end.
7. Pipe without vacuum filled with water as under 6, air and drain cocks closed.
8. Pipe without vacuum filled with water the same as under 6, air and drain cocks open.

In the experiments with the first pipe, steam was admitted from a boiler under 70 pounds pressure, by rapidly opening the stop valve on the main steam pipe, the influx of steam having been regulated beforehand by adjusting the valve close to the experimental pipe. Beginning with one-fifth of the area of this valve the opening was increased one-fifth in each of the succeeding tests, the whole tests being frequently repeated to check results. In carrying out tests 1 to 4 no motion was observed, whether the filling of the pipe with steam was retarded or accelerated. The pipe became heated slowly or quickly, according to the rapidity with which it filled with steam, until it became thoroughly warmed, and the pressure gauges on the pipes showed same as boiler. As soon as vacuum formed and a small amount of condensed water was present in the pipe (test No. 5), light hammering was present in the pipe when steam was admitted. This was not, however, indicated on the gauges, but caused a slight movement of the pipes. This hammering and backward and forward movement of the pipe became more intense the greater the quantity of water present (tests 6 and 7), manifesting itself in distinct blows at short intervals, and causing the gauges to show between 126 to 242 pounds. Whether the vacuum in the pipe (test 6) had any influence on the action of the steam when admitted, could not be determined by any of the trials.

The heaviest hammering, as well as the greatest

movement of the pipe—which also continued for some length of time—were observed when the pipe was about one-third full of water, and both the air and drain cocks kept open (test No. 8) and for all five openings of the valve. During these tests there was a uniform discharge of water from the drain cock and of air from the air cock, for a longer or shorter time, depending on the opening of the stop valve in the pipe. For instance, with one-fifth opening of the stop valve the first hammering was noticeable after four minutes; at three-fifths opening, after 30 seconds; and 15 seconds after the valve was wide open, powerful hammering and violent motion of the pipe set in, in each case accompanied by an impulsive discharge of water and air and later by steam from the air and drain cocks. These phenomena are due to the fact that the steam is condensed by the water present, and only when the water has attained the temperature of steam does the impulsive action of the latter set in. The pressures observed on the gauges at the end of each trial (test No. 8) fluctuated between 284 and 1066 pounds. At one time the greatest pressure would be observed on the gauge tapped in the flange at end of pipe, and then on the gauge on side of pipe.

The second experimental pipe was changed somewhat from time to time, but showed no radical change in results.

As a result of these tests it is shown that destruction of a completely drained, though entirely cool, pipe cannot occur, whether the stop valve near the boiler under steam is opened gradually or in a sudden, careless manner, because hammering, which alone can cause an explosion, does not follow. But it is to be observed that a rapid filling of the pipes with steam may prove disastrous, for the sudden heating up of the various parts may cause rupture, due to unequal stresses on and resistance of the material.

When, however, a large quantity of water is contained in the pipes and the steam is forced to find its way through it and to carry it along, an explosion may occur, even if the stop valve is opened in the slowest and most careful manner. If there is so little water in the pipe that steam need not force its way through it, no disastrous hammering will occur, nor will the water present be carried along by the steam when the stop valve is opened, as was demonstrated by the amount of water left in the pipe after the end of all tests. The results of the tests with the first arrangement of the second experimental pipe lead to the conclusion that where water has accumulated in U bends of pipes, if the stop valve is opened gradually, the entering steam will distribute itself at once uniformly over the surface of the water, and by virtue of its pressure, in spite of the original condensation, it is not only maintained but steadily increased, and will prevent any agitation of the water, and, consequently, hammering. If, however, a sudden change of pressure and a rapid influx of steam occur, then the water will be agitated and, once in motion, it will cause violent and dangerous hammering in the pipe. Therefore, steam pipes with pockets are to be avoided. The variations of the pressures indicated in the gauges after all the tests leads to the conclusion that the water is thrown backwards and forwards, wave-motion like, caused by the influx of steam, and that the pressure is greater or less, depending on the intensity with which the moving mass of water strikes the opening to which the gauge is attached.

ELECTRIC RAILWAY DEPARTMENT.

MR. CLYDE K. GREEN.

It was our pleasure about three years ago to present to readers of the *ELECTRICAL NEWS* a portrait of Mr. Clyde K. Green, who at that time was electrician for the Hamilton, Grimsby and Beamsville Railway. Mr. Green having since received a promotion in the electric railway field, we again reproduce his portrait, with some particulars of his life.

Mr. Green was born across the border, in the state of Michigan, and after leaving school, engaged in the hardware business at Waterford, Ont., leaving there to accept a position with the Edison Company, of Peterboro', in their electrical works, where he obtained a practical knowledge of electrical manufacturing and was promoted to the position of assistant foreman. On the conversion of the Toronto Street Railway to an electrical system, Mr. Green was offered and accepted the position of foreman of the armature department of that road. His success in this direction having attracted



MR. CLYDE K. GREEN.

the attention of the management of the Hamilton, Grimsby and Beamsville Electric Railway, he was offered the position of electrician, fulfilling the duties in an eminently satisfactory manner.

In February of this year he accepted the management of the Hamilton Radial Electric Railway Company.

It might not be amiss to mention a few particulars in regard to this road. The tracks at present cover a distance of eleven miles, extending from Hamilton to Burlington, by way of Burlington Beach. The rolling stock consists of four very handsomely fitted motor cars, each equipped with four G.E. 1000 motors, two at each end of the car, with double trucks, and guaranteed to make 38 miles an hour. The cars are fitted with regular railroad seats with rattan covering, and have a smoking compartment at rear end. The company have, besides the above motors, baggage cars and trailers for use of excursions and pic-nics. One of the special features of this road is the swing bridge over the canal at Burlington Beach, which is operated by an electric motor and which has worked very satisfactorily.

The International Radial Railway Company, of Hamilton, are reported to have sold \$30,000 worth of stock, and to be waiting until they can dispose of as much more, before commencing the construction of the road.

TORONTO STREET RAILWAY ASSESSMENT CASE.

A DECISION of interest to street railway companies has been given by Judge McDougall.

Last summer a board of county judges decided against the assessment of the Toronto Street Railway Company's rails, poles and wires, and the Court of Revision refused, on the strength of this judgment, to confirm the assessment of the plant of the company in the first, fifth and sixth wards. The City Law Department decided to make a test case and appealed in the name of Controller Lamb and of the Assessment Commissioner against the decision of the Court of Revision in regard to the assessment of \$103,500 in the sixth ward. Mr. Fullerton and Mr. Drayton prosecuted the appeal for the city, and Mr. Laidlaw, for the company, urged lack of jurisdiction.

Judge McDougall delivered a judgment last week, the logical sequence of which will be the assessment by municipal officers all over Ontario of all the rails, poles, wires, mains, etc., which have in many cases up to the present time been exempt.

TROLLEYS GAINING IN ENGLAND.

THE prejudice against overhead wires is fast melting away in Great Britain, as evidenced by the following from a London daily:

"The long controversy as to the best form of mechanical traction for tramways in our large cities seems to be gradually deciding itself in favor of the overhead electric trolley system. This method has already been adopted in several towns, and the corporation of Glasgow has now resolved to give it a trial, after a year or two of deliberation, since it acquired the local tramways. The Tramways Committee has been authorized to spend about twenty thousand pounds on the establishment of the system on an experimental route, that is, on an isolated section of the lines, about two and one-half miles in length."

There are still some old fossils who are afraid of shadows, as witness the following extract from an open letter in another London paper of about the same date:

"Among the many objections against the introduction of the overhead system is one that I particularly noticed in the working of the said system in the city of Toronto, viz., that as the cars pass along the roads the connecting rod from the top of the car where it joins the overhead wire is continually giving off bright sparks, sufficient to frighten nervous people with the fear of possible danger, and also to startle nervous horses."

Blinders on the "connecting rod," or a pair of blue goggles for the "nervous" writer, might solve the difficulty.

Mr. C. C. Kramp, Woodstock, Ont., in remitting his subscription to the *News*, writes: "Am well pleased with the paper. It is welcome every month."

Mr. B. B. Osler, president of the Hamilton and Dundas Railway, states that the conversion of the road to electricity is being delayed by the failure to obtain running privileges over the Hamilton Street Railway Company's tracks within the city limits.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the same time, the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the elementary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstance, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obscure and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SPHERE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBIC AND CIRCULAR MEASURE—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Type)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE IV]

EVOLUTION.

EVOLUTION is the process of finding the root of any number, and is of frequent occurrence in engineers' calculations.

The most important and only cases which I shall refer to is the process of finding the square or cube root of any number.

Example (1): Find the square root of 1521. In formula this is written $\sqrt{1521}$.

$$\begin{array}{r} 15,21 \ 39 \\ 9 \\ \hline 69, \ 621 \\ 621 \\ \hline \dots \end{array}$$

Beginning at the right hand figure 1, count two figures to the left and mark the second as shown in the example, take the figures to the left of this mark 15 and find what number multiplied by itself will give fifteen; there is no number that will do this, since $3 \times 3 = 9$ is too small and $4 \times 4 = 16$ is too large; we therefore take the one that is too small, viz., 3, and place it in the quotient, placing its square 9 under the 15 marked off in the number and subtract, and bring down the next two figures 21, making new dividend 621. To get the new divisor multiply the quotient 3 by 2 = 6, and place as a trial divisor at the left of the dividend 621; find how many times this is contained in the dividend, discarding the last figure on the right; 6 is then contained in 62 nine times. Since we cannot pass this point, we place 9 in the quotient and also in the divisor; then we multiply the whole divisor 69 by this number (9) and place the product under the dividend and subtract. Having no remainder, root is now complete and found to be 39. If we require proof of this we simply square the number, thus:

$$\begin{array}{l} 39 \times 39 = 1521 \\ \text{then } 39^2 = 1521 \\ \text{and } \sqrt{1521} = 39 \end{array}$$

Example (2): Find the square root of 366.

$$\begin{array}{r} 3,66 \ 19,131126 \\ 1 \\ \hline 29 \ 266 \\ 261 \\ \hline 381 \ 5,00 \\ 381 \\ \hline 3823 \ 1,000 \\ 1,1469 \\ \hline 38261 \ 43,00 \\ 38261 \\ \hline 382621 \ 48,3900 \\ 382621 \\ \hline 3826222 \ 101,27900 \\ 7652444 \\ \hline 38262246 \ 447,445600 \\ 229573476 \\ \hline 17872124 \end{array}$$

In this example we proceed to mark off as before and get as our quotient the whole number 19, but since there is still a remainder our root cannot be complete; we proceed as before, but since there remains no more figures in the dividend we annex to new dividend two ciphers and place a decimal point in the quotient to the right of the nineteen. Then proceeding as before we get our trial divisor by doubling present quotient $19 \times 2 = 38$ and place to the left of the dividend 500. 38 is contained in 500 once; we therefore place a 1 in the quotient to the right of the decimal point and annex to the new divisor, multiplying as before and sub-

tracting, we proceed in an exactly similar manner until we have no remainder or until decimal begins to repeat itself or is extended sufficiently to answer our purpose.

Example (3): Find the square root of 15227.56.

$$\begin{array}{r} 1,52,27,56 \ 123,4 \\ 1 \\ \hline 22 \ 52 \\ 44 \\ \hline 243 \ 827 \\ 729 \\ \hline 2464 \ 9856 \\ 9856 \\ \hline \dots \end{array}$$

In a decimal quantity like the foregoing, the marking off differs from the previous examples. Instead of counting twos from right to left begin at the decimal point and count twos towards the left and towards the right. Note: when the first two figures to the right of the decimal is brought down we must place a decimal point in our quotient before extending it.

Briefly, the process of finding the square root of a whole number may for the guidance of the student be described as follows:

First mark off in twos commencing from the right. Then find the number whose square is next less than the figure or figures on the left of the number as the case may be, place this figure in the quotient and its square under the figure or figures already marked off on the left of the number, subtract and annex to the right the next two figures of the number; this then becomes a new dividend. To secure a new divisor, double the quotient by multiplying by 2 and place on the left of the dividend as a trial divisor; find how many times this is contained in the dividend, discarding the right hand figure, place this result in the quotient and also in the new divisor and multiply by same number, placing product under dividend and subtract as before; continue the operation for a new divisor. Bear in mind, however, you must always place two figures to the right of the new dividend.

It will occasionally occur as in our first two examples that the product of the trial divisor multiplied by the new divisor will exceed the dividend. In this case take the next lowest term and proceed as described.

TO FIND THE CUBE ROOT.

Example (1): Find the cube root of 1331.

$$\begin{array}{r} 1,331 \ 11 \ \text{Ans.} \\ 1 \\ \hline 31 \ 300 \ 331 \\ 31 \\ \hline 331 \ 331 \\ \hline \dots \end{array}$$

First mark off three figures from the right towards the left of the number, and we have 1 left. Now, 1 cubed equals one. Place the cube of 1 under the one of the number and subtract. There is no remainder. Bring down the next three figures as a new dividend. Next multiply the one placed in the quotient by 3, and place the product well to the left, as in the example. Next multiply this 3 by the quotient figure 1, and place the result, 3, to the right of where the 3 was placed and to the left of the dividend, and add two ciphers to it, as shown in the example.

This 300 is called the trial divisor. Now see how often it will go into the dividend 331, which we find to be once. Put 1 in the quotient to the right of the one already there, and place 1 also to the right of the number 3 at the extreme left of the example.

Now, multiply this number 31 by the figure last placed in the quotient, and place the result under the trial divisor 300 and add. This now gives us the correct divisor, which we multiply by the last figure placed in the quotient and place result under and subtract from the dividend. There being no remainder, our root is now complete, and we find $\sqrt[3]{1331} = 11$.

Example (2): Find the cube root of 80677568161.

Process:

123	4800	80,677,568,161 4321 Ans.
	369	64
	5169	10677
1292	554700	15507
	2584	1170568
	557284	1114568
12061	55987200	51000161
	12061	56000161
	56000161	56000161

The process to the second figure of the answer is a reproduction of last example.

TO FIND THE THIRD FIGURE OF THE ANSWER.

Multiply the 43 in the quotient by 3, equals $43 \times 3 = 129$; put this well out to the left as before. In the middle column of figures you will see the figures 369 and 5169; add these together, and to their sum add the square of the last figure in the quotient—that is in the present case 3. Then

$$\begin{array}{r} 369 \\ 5169 \\ 3 \times 3 = 9 \\ \hline 5547 \end{array}$$

This number, with two ciphers added, is our new trial divisor 554700. It goes into the dividend 1170568 twice. Place 2 as the third figure of the quotient, and place 2 to the right of the number 129 on the left. Multiply 1292 by this number 2 and place the result, 2584, under the trial divisor and add. Result, 557284 is now the correct divisor. Multiply this number by 2 and place underneath dividend and subtract. Bring down the next three figures. We now have 56000161 as a new dividend.

TO FIND THE FOURTH FIGURE OF THE ANSWER.

Multiply the quotient 432 by 3— $432 \times 3 = 1296$, and place this number to the left. Again in the middle column we have the figures 2584 and 557284; add together and add the square of the last figure in the quotient.

$$\begin{array}{r} 2584 \\ 557284 \\ 2 + 2 = 4 \\ \hline 559872 \end{array}$$

This number, with two ciphers annexed, 55987200, is our new trial divisor, and is contained in the dividend once. Add one to the quotient, also to the number on the left. Multiply and subtract as before. And since we have no remainder our root is now complete, and $\sqrt[3]{80677568161} = 4321$.

There is another method of extracting the cube root which to the student may be simpler and process clearer, since it has the advantage over method just described that when the student has mastered the process of working out the first figure of the quotient he has the rest at his command, as the process is but a repetition, and is the same for four figures as for two.

Find the cube of 1728.

1	1,728 (12	
	1	
	728	
$3 \times 10^2 = 300$		
$3 \times 10 \times 2 = 60$		
$2^2 = 4$		
	364	728

First we mark off the number into quantities of three figures as in previous examples, and selecting the next lowest cube for the first figure of our quotient in the case 1, which is put down in the quotient and as a divisor. The cube of 1 is placed under the dividend and subtracted and next period 728 brought down as a new dividend. Now take the number in the quotient and add a cipher to it, making it 10, square this and multiply by constant 3; we then get $3 \times (10^2) = 300$ which is our trial divisor; for the next line multiply 10 by the constant 3 and multiply the product 30 by the figure placed in the quotient from the trial divisor $30 \times 2 = 60$; place this 60 below the 300 already obtained and add, to the sum of these numbers add the square of the last figure of the quotient, thus, $300 + 60 + 2^2 = 364$. This is now our correct divisor. Multiply by the last figure of the quotient, place underneath the dividend and subtract; being no remainder our root is complete.

APPLICATION OF FORMER STUDIES TO MECHANICAL AND ELECTRICAL ENGINEERING.

Since both numerical and algebraical formula will now be constantly used, it is absolutely necessary that students should endeavor to obtain facility in reading and solving formula generally.

The following signs must therefore receive particular attention, and be committed to memory.

+ is read plus, and means that the number following it is to be added to the number before it; thus, $4 + 3$ is 7.

- is read minus, and means that the number after it is to be subtracted from the number before it; thus, $5 - 2$ is 3.

\times is read multiplied by, and means that the number before it is to be multiplied by the number following it; thus, 3×3 are 9.

\div is read divided by, and means that the number before it is to be divided by the number following it; thus, $6 \div 3 = 2$.

= is read equal to, and means that the quantity after it is of same value as quantity before it; thus, $7 \div 3 = 21$.

9^2 is read as 9 squared, and means that the number is to be multiplied by itself; thus, $9^2 = 9 \times 9 = 81$.

9^3 means same number cubed; thus, $9 \times 9 \times 9 = 729$.

\sim is read the difference between any two numbers, and means the less number is to be subtracted from the greater.

() are called brackets, and mean that all the quantities within them are to be put together first; thus, $5(4 - 2 + 3 + 9)$ means that 2 must be subtracted from $4 - 2$, and $3 + 9 = 27 - 2 = 29$, and then this 29 is to be multiplied by $5 = 29 \times 5 = 145$.

NOTE—When no sign is placed between a quantity and a bracket or a letter, it means that the quantity within the bracket is to be multiplied by the quantity outside. Thus in the foregoing the quantity within the bracket = 29 is to be multiplied by 5, the quantity outside.

SIGNS THAT REPRESENT ROOTS OF NUMBERS.

The sign known as the radical sign is common to all numbers, and is expressed thus, $\sqrt{\quad}$ or $\sqrt{\quad}$. When it is required to express the square root of a number we simply put this sign before it, as $\sqrt{25}$, but if the number for which we desire the square root of is made up of two or more terms then we express the square root by the same sign in front, but with a line as far as the square root extends, as $\sqrt{15 + 10}$, or $\sqrt{5(2 + 3)}$.

The cube root is expressed in a similar manner, but with a small 3 in the elbow of the sign, as $\sqrt[3]{\quad}$; all other roots in exactly same manner; as $\sqrt[4]{\quad}$, and so on.

In mechanical text books the power and root are often combined and expressed thus $4^{\frac{3}{2}}$. This is read as the square root of 4 cubed. Therefore, the numerator represents the power and the denominator the root. In this case the square root of $4 = 2$, and 2 cubed equals 8.

The commonest form in which this is met with in engineering calculations is when the cube root of a number is squared, as $27^{\frac{2}{3}}$ which is read cube root of 27 squared. The cube root of 27 is 3 and 3 squared equals 9, which is the value of $27^{\frac{2}{3}}$.

One of the most frequently occurring errors in algebraic calculations is the misunderstanding of the proper use of the multiplication sign in algebraic quantities and formula, and requires special mention here. For instance, we have the quantity $25 \div 10 \times 2$. It is a common error to say $25 \div 10 = 15$; this multiplied by 2 equals 30. This is entirely wrong, as a moment's reflection will prove to the student, as it clearly reads 25 minus 10 = 2, and the first step should be to multiply $10 \times 2 = 20$; then, $25 - 20 = 5$, which is correct, and not 30, as at first appears.

The student requires to remember the following rule, which applies in all cases:

Multiplication and division signs CONNECT the numbers together between which they occur; plus and minus signs SEPARATE them.

For simplicity and accuracy, it is a good rule when working with complex formula, to first get rid of bracket signs, and then multiplication signs; the operation of computation of formula then becomes an easy task.

NOTE. Next issue will contain formula and rules for spring and lever safety valves and electrical formula.

Mr. Wm. Cross, Chief Engineer of Waterworks, Calgary, writes: "I think the NEWS is getting better as it grows older."

The Dardanelles Mining Co., at Kaslo, have just placed an order with the Rossland branch of the Jencks Machine Co., of Sherbrooke, for a complete mining plant for operating their extensive properties in that district.

SPARKS.

By a recent storm about fifty telephones were burned out at London, Ont.

La Compagnie Electrique de St. Etienne de Malbaie is applying for incorporation.

A dynamo is being installed at the C. P. R. shops, Perth, Ont., for incandescent lighting.

The Hamilton, Grimsby and Beamsville Railway are erecting a new station at Beamsville.

The Cornwall Electric Railway Company is considering the extension of the road to neighboring villages.

The Revelstoke Water, Light and Power Company will sell sufficient shares to put in an electric light and power plant.

The new electric railway at Quebec has been completed and put in successful operation. We hope to publish a description of same in an early issue.

The city of St. Hyacinthe, Que., has just closed a contract with the Jenckes Machine Co., of Sherbrooke, for two pressure filters with a capacity of 750,000 gallons in twenty four hours.

The Kay Electric Company, of Hamilton, has been dissolved. Job & Lynch continue the business on James street north, and Thomas L. Kay has established the Canada Electric Motor Company on Bay street north.

The smoke from the Terauley street power house of the Toronto Electric Light Company is said to have had a bad effect upon the new municipal buildings, and the company have decided to put in smoke consuming appliances.

Mr. J. H. Still has made a proposition to the City Council of St. Thomas to electrify the street railway. The proposed electric road will be six and a quarter miles long, and will cost about \$80,000, exclusive of power house.

The Kootenay Electric Co., of Kaslo, B. C., who have a large water power near the town and purpose using the same for power and lighting, have placed their order with the Royal Electric Co. for a 75 k.w. S.K.C. generator and the necessary transformers and motors.

Word comes from Ottawa of the application for a Dominion charter by a company to manufacture calcium carbide. Its capitalization is \$11,000,000, and the Hon. A. G. Blair, Rufus Pope, M.P., and a number of Canadian and American capitalists are among the applicants.

Harry Smith, engineer at the Wortman & Ward Manufacturing Company's factory at London, Ont., was recently badly burned. He was engaged in throwing the refuse oil and varnish into the furnace, when the flames suddenly shot out into Mr. Smith's face, burning his hair and whiskers off.

Mr. A. J. Corriveau, of Montreal, succeeded in getting his railway bill through parliament before the close of the session. He now has the right to construct electric lines between Montreal,

St. Johns, St. Hyacinthe, Sherbrooke, Magog, Waterloo, and other points, and hopes to have the road completed within one year from the present time.

Mr. Pamphile Boivin, of the town of Baie St. Paul, Que., has received a franchise from the corporation of that town for electric lighting, and the Royal Electric Co. is now installing for him an electric lighting plant, consisting of a 500-light S. K. C. dynamo, with the necessary transformers and material. It is expected that the plant will be in operation about the 1st of September.

A decision has been rendered in the appeal case of the city of Montreal against the Standard Light and Power Company of that city. The Lachine Rapids Hydraulic and Land Company, which obtained a controlling interest in the Standard Company, made excavations preparatory to laying conduits in the city under the latter's act of incorporation. The city objected and sent a squad of police to prevent the men digging. A legal injunction was secured enjoining the city. The matter has been carried to the Privy Council, and the company succeeds.

MOONLIGHT SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 8.00	A. M. 4.10	8.10
2.....	" 8.20	" 4.20	8.00
3.....	" 8.20	" 4.20	8.00
4.....	" 9.30	" 4.20	6.50
5.....	" 10.00	" 4.20	6.20
6.....	" 10.50	" 4.20	5.30
7.....	" 11.40	" 4.20	4.40
8.....	" 12.30	" 4.20	3.50
9.....	A. M. 12.30	" 4.20	3.50
10.....	" 2.00	" 4.20	2.20
11.....	No light.	No light.	....
12.....	No light.	No light.	....
13.....	No light.	No light.	....
14.....	No light.	No light.	....
15.....	P. M. 7.30	P. M. 9.10	1.40
16.....	" 7.30	" 9.30	2.00
17.....	" 7.30	" 9.50	2.20
18.....	" 7.30	" 10.10	2.40
19.....	" 7.30	" 10.30	3.00
20.....	" 7.30	" 11.00	3.30
21.....	" 7.20	" 12.00	4.40
22.....	" 7.20	A. M. 1.00	5.40
23.....	" 7.20	" 2.10	6.50
24.....	" 7.20	" 3.10	7.50
25.....	" 7.10	" 4.20	9.10
26.....	" 7.10	" 4.30	9.20
27.....	" 7.10	" 4.30	9.20
28.....	" 7.10	" 4.30	9.20
29.....	" 7.10	" 4.30	9.20
30.....	" 7.20	" 4.40	9.20
31.....	" 7.30	" 4.40	9.10

Total, 158.50

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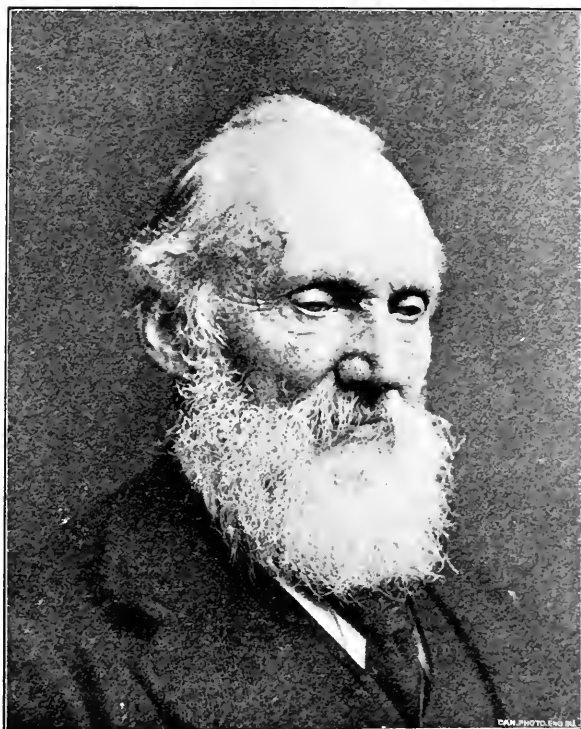
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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VII.

SEPTEMBER, 1897

No. 9.



LORD KELVIN, M.A., D.C.L., F.R.S.E., Past President of the British Association.



PROF. OLIVER J. LODGE, D.Sc., F.R.S.



PROF. W. E. AYRTON, F.R.S.



MR. W. H. PREECE, C.R., F.R.S.

GROUP OF BRITISH ELECTRICIANS

BRITISH ELECTRICIANS.

ON the previous page appear the portraits of several British electricians who were in attendance at the recent convention in Toronto of the British Association for the Advancement of Science. Lord Kelvin, long known as Sir William Thomson, is one of the most eminent scientists of to-day, and to him is due in no small degree the wonderful advancement which has been made in the development of electricity in recent years. He was born in Ireland in 1824, and graduated at several colleges. From 1846 to 1852 he was Fellow in St. Peter's College, Cambridge, and since that time his life has been devoted to the progress of physical science. To telegraphy Lord Kelvin's services have been of peculiar value. He acted as electrician for the Atlantic cable, 1857-58 and 1865-66; he invented the mirror galvanometer and siphon recorder in connection with sub-marine telegraphy; he acted as electrical engineer for the French Atlantic cable, 1869; the Brazilian and River Plate, 1873; the West Indian cables, 1875, and the Mackay-Bennett Atlantic cables, 1879. He has invented a mariner's compass and navigational sounding machine, and many electrical measuring machines. His work has been of immense value in promoting commercial intercourse. The successful completion of the Atlantic cable in 1866 brought him knighthood, and in 1892 he was created a baron. Last year he celebrated his jubilee, which was a notable event in the world of science.

Professor Oliver J. Lodge was born in Staffordshire in 1851, and has been Professor of Physics in University College, Liverpool, since 1881. He has given considerable attention to electrical matters, and is the author of numerous publications, including "Elementary Mechanics," "Modern Views of Electricity," "Pioneers of Science," "The Work of Hertz and His Successors," and "Lightning and Lightning Guards."

Prof. Ayrton is now in his fiftieth year. He is a Londoner, and entered the Indian Telegraph service in 1867, and afterwards pursued his studies under Lord Kelvin. When he went to India he became assistant to the Electrical Superintendent of the India Government Telegraph Department, returning on leave to England in 1872, and being employed on various matters relating to telegraphy, including the electrical testing of the Atlantic cable in 1873. On the establishment of the Japanese Imperial College of Engineering, he was offered the Professorships of Physics and Telegraphy, which he held until 1878. In 1884 Prof. Ayrton was appointed Professor of Applied Physics at the City and Guilds of London Central Institution. He is a joint editor of Messrs. Cassell's "Manuals of Technology," having written one of the series, "Practical Electricity," which has run through several editions. He gave a valuable lecture at Bath in 1888 entitled "The Electrical Transmission of Power."

Mr. W. H. Preece was born in Wales in 1834. He was appointed to the Electric and International Telegraph Co., 1853, becoming superintendent of the Southern Division in 1856. After attaining eminence in the telegraph world he was in 1870 transferred to the General Post-office as Divisional Engineer, in 1877 being appointed Engineer, and in 1892 Engineer-in-Chief, and is also Consulting Engineer to the Colonies. He has been associate author of text books on telegraphy and the telephone.

QUESTIONS AND ANSWERS.

Mr. "J. G." writes: I have been thinking of using my exhaust steam from lighting engine to heat our building, but do not know how to do it without putting on back pressure, which I wish to avoid. Our building is four stories high, and is piped on the two-pipe system, carrying steam at 15 lbs. I understand there is a system of exhaust steam heating, but the royalties charged are excessive, as far as I can make out. I would like to know if there is any other way, if not quite so elaborate as the patent way, may be. Details will be much appreciated.

Mr. James Johnstone asks: What would you advise me to do with my plant to bring down the temperature of my flue gases, as I find they are about 600° on entering the chimney, and this, I believe, is 200° too much. We use soft coal; common tubular boiler; fair draft; no forcing, and plant ample size; steam 85 lbs.

SIR,—I would like if some of your readers could advise me (1) what to do to keep the oil off a belt on the governor side of a high speed engine, and also what to do to extract the grease or oil from the belt. A handful or two of whitening I find to be a good thing to put on the belt when it slips badly, and will cure it for three or four hours. Sometimes I scrape it off (when running), but often I don't. (2) What advantage or disadvantage is there in raising or lowering the speed of a high speed engine? (3) When running a high speed automatic cut-off engine, which is the more economical pressure, at from 50 to 80 lbs.? Also, when running pumps and drying room coils and common 10 h.p. engine, I can carry anywhere from 40 to 80 lbs. Which is the best pressure, and why?

"ONTARIO."

"Subscriber" writes: I have a flue about 20 feet long from my two boilers to chimney, and would like to have the opinion of others as to whether I could, by placing water pipes on the outside on top, get a high enough temperature in the water to be worth the trouble and expense. We use about thirty feet an hour for each boiler. The flue is extremely hot—must be about 400° to 500°. Is it possible that it might help to destroy the draught by cooling the flue and lowering the temperature inside? It is not too good at present. I would like suggestions in detail. How can I figure out to see if a 12 x 9½" Armstrong & Sims' engine, running at 280 rev., 80 lbs. steam, will drive 250 amperes at 115 volts?

James McPherson asks: Would some of the boys tell me what is the best kind of oil to use in the hydraulic cylinder of an elevator? Ours has not had any for four years, but I think it should get some.

[Readers of the ELECTRICAL NEWS are requested to forward replies to any or all of the above questions before the 28th of September, in order that the answers may appear in our October issue.—THE EDITOR.]

TO OVERCOME THUMPING.

SIR,—For the benefit of brother engineers I thought I would tell them of how I got over the trouble of a thumping in the water end of my pump, and hope it may be of use to some one likewise situated. In the first place, it was getting water under a head of about 30 lbs., and pounded frightfully, but when pumping out of the tank she would run all right. However, as we could only use the tank occasionally, we had to suit her to circumstances. Air chambers I stuck on in abundance, on both sides of pump and on top of tank 70 feet high, where she pumped to; I also placed one 5 ft. x 8" on pump in place of small original one. I put on strong springs on suction valves and throttled the head of water, but all to no purpose—pound she would. At last I put on a little air valve on the suction pipe, and throttled the water until she had to draw her water the least little bit, and then very slightly opened the air valve, when all at once the trouble ceased and the pounding was no more.

A. ALEXIS.

It is understood that the Cornwall Electric Street Railway Company are making arrangements to extend their line to the Ottawa & New York railway station, 1½ miles distant.

The corporation of Magog, Que., are installing a 1,000 light single-phase alternator and other apparatus for their new incandescent lighting plant. The street lighting will be done by sixty 50 c. p. incandescent lamps, which are expected to furnish a much more satisfactory street lighting service than their equivalent of arc lamps. The apparatus is being furnished by the Canadian General Electric Company, of Toronto.

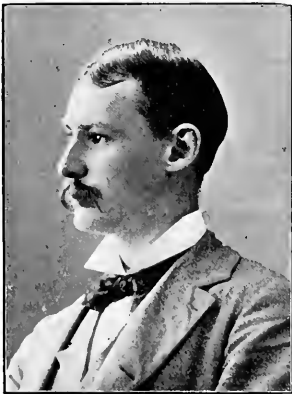
WESTERN ONTARIO LIGHTING PLANTS.

EXETER ELECTRIC LIGHT COMPANY.

The Exeter Electric Light Company was organized during the present year, through the efforts of Mr. R. C. C. Tremaine, who became manager. The plant, when completed, will consist of a G. E. 60 k. w. alternator and one 20 Royal arc machine, with usual switch board and instruments from the General Electric Company's works. The circuit is about $6\frac{1}{2}$ miles in length. A boiler, 66×14 , with eighty-four $3\frac{1}{2}$ inch tubes, and a Brown engine, 14×36 feet, furnishes the power. The power house is a two-story brick structure, 34×80 feet, with stone foundations and smoke stack of iron, 60 feet high.

When Mr. Tremaine assumed charge a few weeks ago there were about 350 incandescent lights in use. At the present time a staff of workmen are busily engaged wiring an additional 900 lights.

Mr. Tremaine is a native of Nova Scotia. He was born at Dartmouth, opposite Halifax, on November 4th, 1874. After passing through the public and high schools he, in 1891, entered the School of Practical Science at Toronto, graduating as B. A. Sc. in 1894, and taking a post graduate course in 1895. In the summer of the same year Mr. Tremaine took charge of the electric



MR. R. C. C. TREMAINE.

light plant at Long Branch, which position he filled for two seasons, when he removed to Exeter and formed the present company.

DURHAM ELECTRIC LIGHT PLANT.

Messrs. Kilmer, Crawford & McIntyre are the owners of the Durham plant, which was installed just one year ago. The power house, situated on the Rocky Saugeen river at Aberdeen, four miles from Durham, is a substantial frame building, 20×40 feet, with metallic sidings. Power is furnished by a Barber 90 h. p. water wheel. The generator is from the works of the Canadian General Electric Co., being a 75 k. w. monocyclic, the switch board and instruments being from same firm.

This company have about sixteen miles of wire and over 900 lights, and will shortly install a number of 50 c. p. street incandescent lights.

MOUNT FOREST ELECTRIC LIGHT PLANT.

The electric light was first introduced in Mount Forest in the year 1885, the present owners, Messrs. Corley & Collins, purchasing the plant from the former owners in 1890, and running only an arc system until 1893, when they installed an incandescent plant.

The power house is centrally located. Steam power is supplied by a Wheelock 140 h. p. engine and boiler, operating a 500 light National generator for incandescent system, 20 light Ball arc machine, 2000 c. p., with switchboard fitted with National instruments.

This company have 14 arc lamps and 350 incandescent lights installed, and are about to increase the number.

Mr. T. H. Collins acts as manager, and under his supervision an excellent service is being furnished.

CHESLEY ELECTRIC LIGHT PLANT.

This plant, owned by Mr. R. T. Bearman, is under the management of Mr. J. H. Fry. The power house is situated on the north branch of the Saugeen river, about $1\frac{1}{2}$ miles from the town. Power is supplied by two turbine water wheels of 100 and 50 h. p. There are over eight miles of wire, and there are installed 300 incandescent lights, 34 arc street lamps, and 25 50 c. p. street incandescent lamps. The generators are a 500 light Reliance and a 25 and 35 Reliance arc machines, with full complement of instruments.

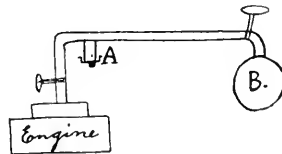


MR. J. H. FRY.

Mr. J. H. Fry, the electrician in charge, is a native Canadian, born near Port Hope, May 30th, 1864. He has been in charge of the present plant for over six years.

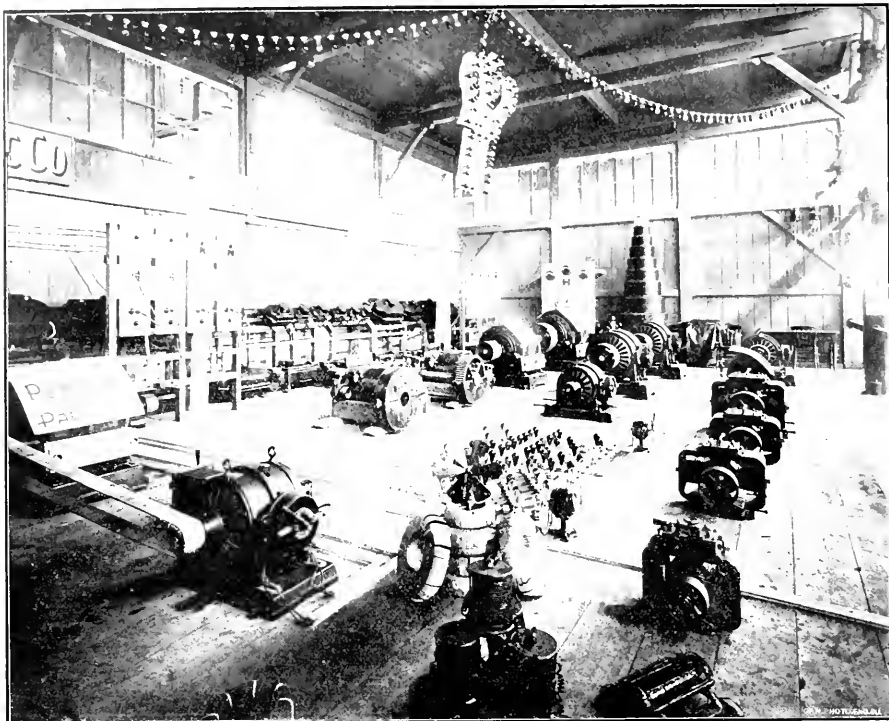
BOILER ACCIDENT AT LONDON.

LEONARD J. Grimshaw, a machinist employed by E. Leonard & Sons, of London, was killed in Watson's box factory recently. He was engaged putting in a new high speed Ball engine, and had started up steam before work on the engine was completed. The cap of the drip attached to the pipe used to conduct steam from the boiler to the engine blew out a short time after the engine was started. Deceased was standing right under the drip at the time, and was covered by the condensed steam. The force of the explosion sent him

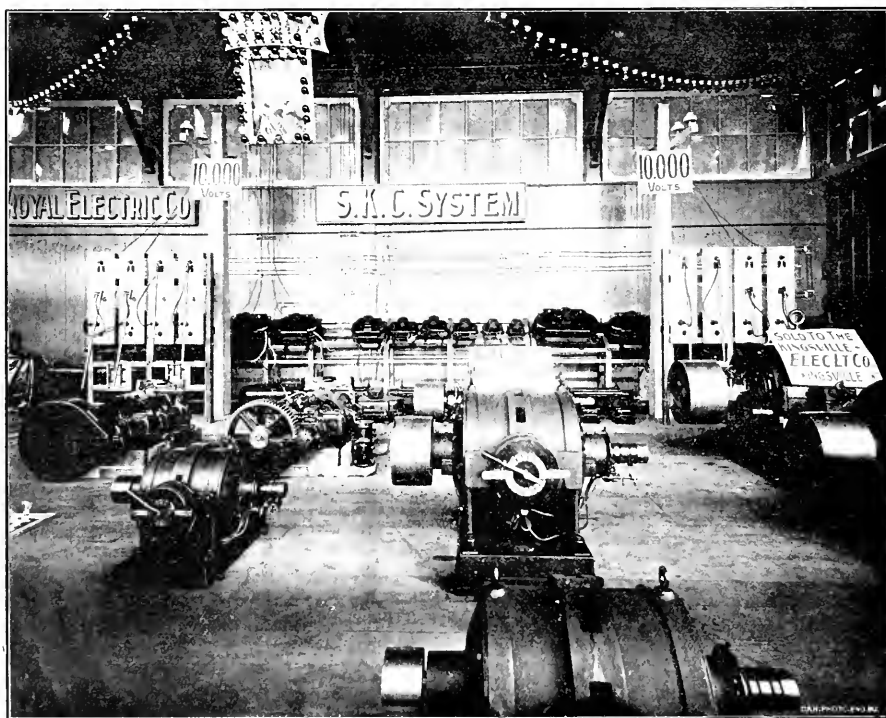


into a small hole about ten feet away. In the accompanying illustration, showing how the accident occurred, A is the drip pipe, with a cap (cast iron) at the end, tapped for $\frac{3}{4}$ or 1 inch pipe, and B the steam boiler. The pipe connections for drip had not been made at time of accident. The metal of the cap at bottom was $\frac{7}{16}$ inch, and the bottom blew clean out, but the thread never stripped. The steam pipe and drip were five inches in diameter.

The Doherty Organ Company, of Clinton, requiring an increased dynamo capacity, have placed an order with the Canadian General Electric Company for a 200 light incandescent machine of the Edison type.



GENERAL VIEW OF THE EXHIBIT OF THE ROYAL ELECTRIC COMPANY AT THE INDUSTRIAL EXHIBITION, TORONTO, SEPTEMBER, 1897.



VIEW OF THE EXHIBIT OF THE ROYAL ELECTRIC COMPANY AT THE INDUSTRIAL EXHIBITION, TORONTO, SHOWING THE HIGH VOLTAGE TRANSFORMERS AND SPECIAL SWITCH-BOARDS.

EXHIBIT OF ELECTRICAL APPARATUS.

ONE of the most interesting and unique exhibits at the Toronto Industrial Exhibition now in progress is that of electrical apparatus. There is a noticeable improvement in the display as compared with former years, although a number of the manufacturing companies are not represented. The growing interest in electrical apparatus is attracting many visitors to the east wing of Machinery Hall, where the exhibit is located. Each company has sufficient space to permit of the proper and most advantageous arrangement of the machinery, and the effect produced in the evening by means of the many colored lights is pleasing in the extreme.

The Royal Electric Company, of Montreal and Toronto, has practically two exhibits. Near the centre of the hall are located two Leonard engines of 60 and 100 h.p. The larger engine drives two Royal Electric Thomson-Houston 50-light arc dynamos, belted in tandem, these machines being used for lighting the machinery hall and other buildings. Belted to the 60 h.p. engine is an "S.K.C." two-phase generator, and set up near by is a switchboard complete. Behind the switchboard there are connected up two large transformers, which take up the full capacity of the machine. This generator furnishes the current for about 400 colored incandescent lights arranged over the company's exhibit in another part of the building. The above portion of the exhibit may be said to represent a thoroughly equipped central station, including arc and incandescent lights and motors complete.

Passing to the extreme east end of the building, we reach what may be termed exhibit No. 2. Here the 400 incandescent lights above referred to are arranged in festoons near the ceiling over the company's exhibit in such a manner as to give the most pleasing effect. In the centre is a crown of about 150 lights, while extending from the crown to the four corners of their space are rows of colored lights, numbering in all about 250. They have also on view twelve alternating current arc lamps, among them being some that burn 100 hours with one carboning.

On a large table is displayed a complete line of electrical supplies, while a pyramid of Royal sterling rubber covered wire is also to be seen. The machinery here exhibited includes a range of the well-known S.K.C. transformers, ranging from a miniature of 10 lights to one of 1200 lights capacity; a range of S.K.C. generators and motors, operating on the two-phase system, from 2 to 50 h.p., with switchboards; direct current four-pole dynamos and motors, and their latest type of street railway apparatus. A special feature of the exhibit is the high voltage transmission line, the current being generated at 2,000 volts and raised by means of step-up transformers to 20,000 volts, at which pressure it is conducted over high voltage insulators on the model pole line and again stepped down from 20,000 to 2,000 volts, and used in the regular S.K.C. transformers to illuminate the building. This portion of the exhibit is particularly interesting, inasmuch as the Royal Electric Co. are making a specialty of high potential work and long distance transmission, and this display is intended to illustrate a complete long distance transmission and distribution line.

By a specially constructed switchboard the danger to operators in transmitting under a pressure of 20,000 volts is entirely removed, as the switches are so arranged that there is no possibility of "arcing across" so frequently occurring in high voltage work.

In connection with the display of the Royal Electric Company, it may be noted that a type of every electrical machine made is exhibited. The principal feature noticeable is the tendency to do arc and incandescent lighting, as well as all kinds of power work, with alternating current, and judging from the various sizes of alternating and induction type motors shown, there appears no hesitancy about putting them on the market and guaranteeing results. Some conception of the magnitude of their exhibit may be obtained from the fact that four car loads of machinery were brought up from the factory in Montreal for the purpose, the work of erecting the same being done under the supervision of Mr. James Fleet, the company's expert.

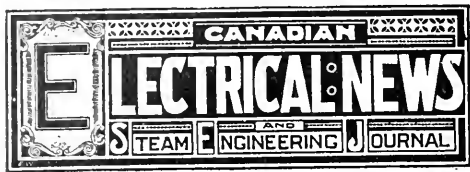
Entering the Machinery Hall from the south, we find on our right an attractive exhibit by the W. A. Johnson Electric Company, of Toronto. An Ideal engine, manufactured by the Goldie & McCulloch Company, is driving two 110 volts direct current incandescent dynamos, operating on the three-wire system, furnishing current to incandescent and long burning arc lamps, and supplying incandescent lights for the main building and for operating the cinematographe. A 250-volt power generator drives several motors in different buildings. The exhibit of the company also includes the renowned Wagner transformers, enclosed long burning arc lamps, alternating and direct current ceiling fans, two arc light dynamos in operation for illuminating the main building, and their new 600 light inductor alternator. All the above apparatus are provided with full switchboard outfits, the whole having been manufactured at the Toronto factories of the company, and making a creditable exhibit.

The Kay Electric Manufacturing Company, of Hamilton, and the Jones & Moore Electric Company, of Toronto, each have well-arranged exhibits of dynamos, motors, lamps and general supplies. The former company has also on view a complete switchboard. The motors of the Jones & Moore Electric Company are painted white, presenting a neat appearance.

The special feature of the exhibit of the Toronto Electric Motor Company is their direct connected generators, which are claimed to be the first of the kind ever placed on exhibition in Canada, and from the number of persons who inspected the apparatus it was evident that the innovation was appreciated. A 30 k.w. dynamo is direct-connected to an Ideal engine of 60 h.p., running at 300 revolutions per minute. This generator, together with a complete switchboard, comprising a 600 light plant, was manufactured for the Methodist Book & Publishing Company, and will shortly be installed. There is also shown a smaller dynamo of 15 k.w., connected to a 20 h.p. Ideal engine, running at 550 revolutions and furnishing 110 volts. Motors from $\frac{1}{2}$ to 12 h.p. and arc lamps complete the exhibit. Arc and incandescent lighting and power are furnished from the same machine, and the economy in space by use of the direct-connected generators was freely commented upon.

The Shelby lamp is exhibited by the John Abell Engine Company, who have recently obtained the Canadian agency for these goods.

Owing to the convenient location of their large show rooms on Front street west, within one minute's walk of the Union Station, the Canadian General Electric Company made no exhibit at the Exposition. Many visitors to the city were shown through their immense warehouse, where everything in the line of electrical apparatus could be seen.



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KINCARDINE BRANCH NO. 12.—Meets every Tuesday at 8 o'clock, in McKibbin's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Milker, Waterworks.

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BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, John Grundy; Vice-President, C. L. Bertrand; Recording Secretary, James Atkins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

The Sarnia Tunnel.

The Great Northwestern Telegraph Company have removed once for all the annoyance and expense occasioned

by the destructive action of acid upon their wires in the Sarnia tunnel, by enclosing them in a lead cable. Under the direction of Mr. A. B. Smith this new cable, encased in a wooden conduit, has been laid in a trench eighteen inches underground, alongside the railway tracks. The cable measures over 6,000 feet and weighs about 18 tons.

Steel Standards for Boilers.

ALL steel used for boilers of steamships constructed under Lloyd's rules is now required to have an ultimate tensile strength of not less than 26 tons, and not more than 30 tons per square inch of section, and the ultimate elongation must not be less than 20 per cent. in a length of 8 inches. It is to be capable of being bent to a curve, of which the inner radius is not greater than one and a half times the thickness of the plates or bars after having been heated uniformly to a low cherry-red, and quenched in water at 82° F.

Growth of Electric Lighting.

IN the towns and villages of Ontario it is gratifying to observe the rapid growth of electric lighting, both for public and private use. New plants are constantly being installed in places where coal oil and gas has heretofore been the only illuminants, and frequent extensions to circuits are rendered necessary by the growing appreciation of electricity in places where this system of lighting has been employed. While the greatest advancement in this direction has been made in Ontario, it is by no means confined to this province. Throughout the entire Dominion the outlook for the electric lighting business is somewhat encouraging. In the maritime provinces many saw mills have recently been equipped with isolated plants, by means of which night

work is permitted, and it is thought that this branch of the industry will be considerably extended in the near future. These statements will, we believe, be borne out by the electrical manufacturing companies, who have enjoyed a comparatively good business during late years when commercial depression was almost general. True, the cost of electrical apparatus has been much reduced within a short period of time, leaving a smaller margin of profit to the manufacturer, but this has in a measure been offset by the greater volume of trade. A still wider adoption of electricity for lighting purposes will be witnessed before the close of the nineteenth century.

Electric Motor-Cabs.

WHILE in European countries gas and steam-motor propelled vehicles for road purposes have attained the greatest degree of success, experiments made in America would seem to be in favor of electricity as the motive power. The Electric Carriage and Wagon Company have inaugurated in New York city an electric-motor cab and carriage service, which is said to be meeting with much success, the power being furnished by storage batteries. Results show that about 1.25 horse power is necessary for the propulsion of 2,000 pounds over ordinarily approximately level roads at ten miles per hour. During the month of June 1,580 passengers were carried by these cabs a distance of 4,603 miles. The rates charged are one dollar for the first two miles or any part thereof, and 50 cents for each extra mile. It would appear that the field for the electric carriage was gradually widening.

The Progress of Science.

No better illustration could be found of the rapid strides which have been made of late years in the field of science than is afforded by a perusal of the proceedings of the British Association for the Advancement of Science, which for the first time in its history convened in Toronto in August last. To the city it was a source of congratulation that men who are so prominently identified with the progress of Great Britain should have assembled in Toronto in such large numbers. It is said that general surprise was expressed at the beauty of the Canadian cities visited, as well as at the abundance of natural resources possessed by the Dominion of Canada. As these impressions are made known throughout the countries of Europe, benefits to Canada are likely to follow. It was pleasing to observe that of the various branches of physical and natural science, that of electricity received perhaps greater attention than any other. There were present at the meeting a number of well-known electricians, who took an active interest in the proceedings. A paper of more than ordinary value was read by Prof. Ayrton, entitled "Some Tests on the Variation of the Constants of Electricity Meters with Temperature and Current," the author being Mr. G. W. Donald Ricks. The discussion following showed that an opinion existed that electric meters register more accurately than gas meters, but that there is still much room for improvement in them. There is a growing demand for a meter that will work accurately and can be purchased below the present cost. Some other papers of electrical interest were: "On a Method of Determining the Specific Heat of a Liquid in Terms of the International Electric Units," by Prof. H. L. Chandler and H. T. Barnes; "On the Fuel Supply and Air Supply of the World," by Lord Kelvin; "On the

Constitution of the Electric Spark," by Arthur Schuster; "An Electric Curve Tracer," by Prof. G. B. Rosa; "On the Source of Luminosity in the Electric Arc," by Henry Lerew and Mr. Basquin; "The Sensibility of Galvanometers," by Prof. Ayrton and Prof. J. V. Jones; "On Some New Forms of Gas Batteries and a New Carbon Consuming Battery," by Willard E. Case. A paper by Mr. G. C. Cunningham, late manager of the Montreal street railway, was also read.

An Immense Water Power Scheme.

STEPS have been taken by the St. Lawrence Construction Company, composed largely of British capitalists, to carry out an immense electrical water power development scheme at Messina, N. Y. Near this point the St. Lawrence river runs through a series of rapids, and in the course of seven miles there is a fall of 56 feet. About three miles from these rapids there runs the Grass river, some 300 feet wide, which takes its course through a gorge nearly 50 feet deep. It is proposed to cut a canal through the level plateau and to establish a power house on the banks of the smaller river. The water would be delivered upon turbine wheels with an absolute head of over 40 feet, and after actuating the turbines, would flow through the valley of the Grass river and re-enter the St. Lawrence below the rapids. The canal is intended to develop 150,000 horse-power, of which one-half will be rendered available in the first instance. Contracts for the entire work have been let, and the company hope to have the undertaking completed by December, 1898. The electrical apparatus, including fifteen 5,000 h. p. generators, are being manufactured by the Westinghouse Electric and Manufacturing Company, of Pittsburg. Each generator will weigh about 350,000 lbs., and will stand 22 feet high above the top of foundations. It is estimated that the entire plant and canal will cost in the neighborhood of two million dollars, and that power can be sold at fifteen dollars per horse power per year, running twenty-four hours.

OUTLOOK FOR MECHANICAL ENGINEERS.

W. S. G. writes: May I ask as a favor your opinion as to what the prospects are for those graduating in Electrical and Mechanical Engineering at the School of Practical Science, Toronto? I have seen in your paper opinions both optimistic and pessimistic. Those opinions apply, however, to those graduating as Electrical Engineers. Has not the graduate in the above course also open to him the field in Mechanical Engineering, including draughting, designing, inventing, etc.? I am contemplating taking the above course, but feel that my knowledge of what the profession is, what it includes and what the prospects in it are, is not definite enough. I have always had a liking for applied science and machinery, and have confidence of success along this line. Prof. Galbraith says, "Success depends on the special fitness of the candidate for his chosen vocation." I am at present at home on my father's farm, but, as I said, am contemplating taking this course, and would appreciate very much your opinion and advice.

ANSWER.—It is a difficult matter to advise you as to the course you should pursue in the absence of knowledge of all the circumstances of the case. Speaking in general terms, however, we would say that the engineering colleges appear to be turning out a larger number of graduates than the employment in this line would seem to warrant, and there are many competent engineers, civil, mechanical and electrical, who are unable to find employment at salaries commensurate with their abilities and the expense connected with their education. In view of these facts, you should give the subject careful enquiry and consideration before deciding to enter the field, as it seems to us it is only those who are favorably circumstanced, as to means, education and natural fitness, who can reasonably expect to achieve any large measure of success. Our opinion is that too many young men are forsaking good homes on the farm to enter commercial and professional lines. We believe that a young man who understands farming in a scientific manner and has some means at his disposal with which to make a start, is more likely to secure a comfortable living and a fair competency than the one who comes to the city and takes a professional course.

NEW BUILDING AND EQUIPMENT OF THE BELL TELEPHONE COMPANY, MONTREAL.

THIS company's new building, at the corner of Notre Dame and St. John streets, Montreal, contains the head office, eastern and local department offices, electrical engineering department, main exchange, distributing room, power room, and various other departments, including the Montreal agency. The Merchants Bank of Halifax occupies a large portion of the ground floor; the Royal Victoria Insurance Company and the Northern Electric & Manufacturing Co., Limited, have offices on the first floor, and the first and third floors are laid out principally for offices to be rented. A corridor ten by one hundred and thirty feet (10' x 130') long runs from Notre Dame street to Hospital street, with a large vestibule at each entrance. Off this corridor are the entrances to the elevators, stairways, Montreal agency, long distance booths and the banking room. The bank is large, commodious, handsome and well arranged, the room being thirty-six ft. wide by one hundred and twenty-two feet long.

The vault in the bank was built by Messrs. J. & J. Taylor, Toronto, and is one of the most expensive and strongest safety deposit vaults ever built in Canada. The door of the vault, including the bolt work, is over a foot thick, made of chrome steel, according to the most modern practice in safe construction, and the walls, floor and ceiling are all of strength and thickness proportionate to the door. In connection with the vault are examining boxes for depositors and a book vault. There is also a directors' room, lunch and coat rooms, and a lavatory.

THE BELL TELEPHONE COMPANY'S OFFICES.

The whole of the second floor is divided into offices for the company, which also occupies a portion of the third floor. The board room on the second floor is 18' by 28'. This room, together with the president's office, occupies the Notre Dame street frontage on this floor. The other offices on this floor are the general office and those of the secretary-treasurer, stenographer, general superintendent and special agents. There are also book vaults.

On the third floor are located the engineering department, drafting office and testing department, power room, photographic dark room and long distance test

room. The operating room, which is 36 feet wide by 110 feet long, and 18 feet high, is on the fourth floor. It is lighted with large windows on all sides, and has a large prismatic skylight in the roof.

In order to protect the telephone apparatus in this room from fire, which would mean an enormous loss to both the company and the business community, it was necessary to construct the most fire-proof building possible. The floors, roof and walls are all made of incombustible material, and every window on the floor is provided with rolling steel shutters. The skylight over the operating room is of double thickness, and nothing has been omitted to guard and protect the whole from fire.

Off the operating room is the operators' lunch and reading rooms, a locker room, a lavatory, a steam clothes dryer and bath room. The rest of the floor is taken up by the janitor's quarters.

In the basement the underground wires enter the building at three points. They are assembled in the

distributing room, and from thence pass to the operating room in a fire-proof shaft. In the basement also are located the linemen's room, store room, engine room and boiler room.

The heating apparatus of the building consists of two Babcock and Wilcox boilers of the latest pattern; two immense Sturtevant steel fans



BELL TELEPHONE CO.—HEAD OFFICE AND MAIN EXCHANGE, MONTREAL.

and independent vertical engines; a large steam coil, which draws the fresh cold air from an open court, heats it and forces it under pressure to every room in the building, and the vitiated air is exhausted through the corridors and elevator shaft, through roof ventilators and back to the outside entrance. The air, before delivery, is filtered, washed and dried, and is changed throughout the entire building once every eight minutes. The building is completely lighted by both gas and electricity, all the electric light wires being run in armoured conduits. There are two hydro-steam elevators.

The exterior walls are of brick and terra cotta, these being the best fire-resisting materials known for the purpose. The ground floor is of red terra cotta, the rest of the building being of buff brick and terra cotta.

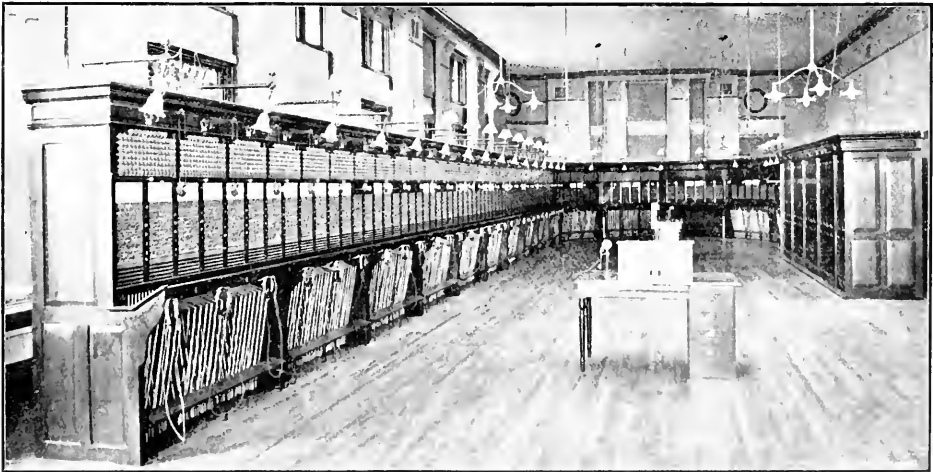
With regard to the electrical features, commencing at the basement—the subscribers' lines enter the building in cables of two hundred wires each, all cables entering underground. The cables are hermetically sealed into

iron terminals, or cable-heads, and the various pairs of wires are led to binding posts mounted on the sides of the cable-heads, but insulated from it. The cable-heads are secured to an iron-supporting framework of ingenious design, ample provision having been made for future increase. Close to this framework is the "main distributing frame," which is also an open iron framework, somewhat resembling the cable-supporting apparatus. To one side of this frame are connected the underground cable-heads by means of small cables de-

scribed somewhat more complicated, consisting of a small coil of German silver wire, wound on a hollow brass spool, a short metal rod passing through the hole in the spool, being held in place by a drop of fusible alloy, the whole mounted in a rubber case. This contrivance is held between two springs. When a current greater than the apparatus will stand, commences to flow in the circuit, the spool heats, melting the fuse metal and releasing the pin, and this allows the line to ground, cutting off the heavy current from the office.



BELL TELEPHONE CO.—GENERAL VIEW OF OPERATING ROOM, SHOWING LOCAL AND LONG-DISTANCE SWITCHBOARDS.



BELL TELEPHONE CO. VIEW OF LOCAL SWITCHBOARD.

signed for indoor work, while to the other side is connected the cables leading to the switch room. On the side of the rack to which are connected the outside cables are mounted the lightning arrestors and "sneak" current protectors, the combination being well-known, technically, as style Number Four. The lightning arrestor consists of two plates of carbon separated by a ring of mica; lightning or other high potential currents will jump the air gap to ground without passing through the switch proper. The sneak current protector is

The two sides of the main frame are connected by separate pairs of "jumper" wires, a special "flame-proof" insulation being used. At this frame are made all changes due to new work, removal of instruments, changes in location of instruments, and, in fact, all causes.

OPERATING ROOM.

Leaving the main frame the lines pass, in cables, upstairs to the fourth floor, where the switch room is situated. Here the cables are connected to the inter-

mediate distributing frame, which is very similar to the frame down-stairs. This frame is used as a connecting point between cables from the main frame and cables to the switch board. Changes can be made here in order to rearrange the lines coming to any operator, for the purpose of equalizing the calls she will have to answer. For instance, if at a certain season of the year a particular line is used much oftener than usual, this line can be taken from the regular operator and put on another operator, who has fewer calls to answer, thus balancing the work.

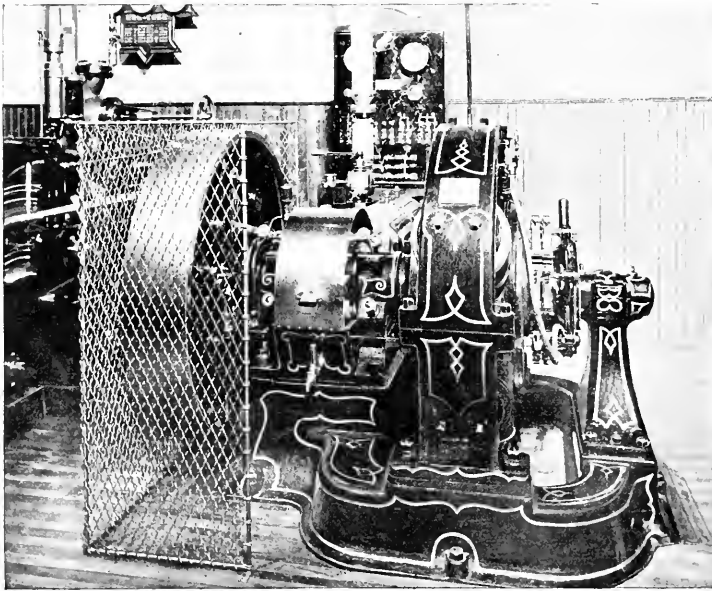
The switch-board proper is of the "branch terminal multiple" type, wired for 3,600 lines and having an ultimate capacity of 4,800 lines. At present 2,500 lines are working in this office. The number of lines an operator can attend to depends on the number of calls per line. In addition to the local positions there are several operators who receive calls from the branch offices and the long distance switch. All switchboard circuits are metallic throughout the switch.

A noticeable feature of the switch is the use of miniature incandescent lamps as signals. There is one in front of each operator, which glows as long as a drop

motor generators are used for ringing subscribers' bells. An elaborate switchboard is used for controlling these various power circuits. The very best material and workmanship has been employed from start to finish, and the board is thoroughly complete and up-to-date, comparing favorably with any exchange in the world.

A COMPLETE ISOLATED PLANT.

THE Canadian General Electric Company have recently installed for the O'Keefe Brewery Company, Limited, of Toronto, what is probably the completest isolated plant installed up to the present in any manufacturing establishment in the Dominion. The generator consists of a 25 kilowatt steel frame machine, direct-connected to an Ideal engine, running at 305 revolutions per minute. The design and construction of the apparatus are such as to secure the highest possible efficiency, combined with the greatest durability in service. The frame and pole pieces are cast from a specially selected soft steel of the highest magnetic permeability. The construction of the armature is such that currents of air circulate constantly through the core windings and commutator, ventilating them perfectly. The armature windings are



THE O'KEEFE BREWERY COMPANY'S PLANT.

is down in front of her, requiring attention. The lamp not only serves to attract the attention of the answering operator, but also the supervising operator. The chief operator has also a bank of lamps in front of her on her desk, which are connected to the lamps in front of the operators, by means of which lamps the chief can see at a glance how promptly calls are being answered. Lamps are also used to show when inter-office trunk lines are out of use, a new and most desirable feature. The long distance lines come to a separate switch at one end of the room, and are attended to by special operators.

The board has an iron frame, with a covering of polished cherry, and everything about it, with the exception of the wires and cables, was made by the Northern Electric and Manufacturing Company, in Montreal. The board was set up by the Telephone Company's employees, the work of erection taking about eight months, while the actual time of transferring the 2,500 lines, the trunk lines and long-distance lines, was one hour and five minutes. This was successfully accomplished on August 14th.

Power for the self-restoring drops, transmitters, lamps, signals, etc., is obtained from 16 cells of storage batteries, for the charging of which two horse power motor generators are used. Two half horse power

straight copper bars, requiring but two joints for each convolution, rendering short circuits and similar troubles practically impossible, and facilitating any repairs which might become necessary on account of mechanical injury.

The insulation of all the machines of this type is of the best, combining great mechanical strength and durability with high spark-resisting qualities. The increase in temperature up to full load is kept exceedingly low, and the use of carbon brushes insures absolute freedom from sparking under all conditions of load. Since starting up, this unit has shown itself to be entirely satisfactory, requiring practically no attention whatever.

The switchboard consists of a handsome dark marble panel, upon which are mounted the necessary switches and Weston instruments. A triple pole, double throw switch is used to connect the installation with the three-wire mains of the Toronto Electric Light Company, at such times as it is not desired to keep the plant in operation. The installation is one which reflects the highest credit upon the manufacturers, as well as being a source of satisfaction to the O'Keefe Company.

It might be added, that besides the lighting of the brewery, current is furnished to operate several small motors from which fans, ventilators, etc., are run throughout the buildings.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EIGHTH ANNUAL CONVENTION.

BROCKVILLE was honored this year as the meeting place of the eighth annual convention of the Canadian Association of Stationary Engineers. The date, as fixed by the local association, was the 19th and 20th of August.

When the meeting was called to order at 9.30 a.m. of Thursday, there were in attendance the following executive officers:

James Devlin, Kingston, president; E. J. Philip, Toronto, vice-president; W. F. Chapman, Brockville, secretary; R. C. Pettigrew, Hamilton, treasurer; J. Murphy, Montreal, conductor; J. F. Cody, London, district deputy for Ontario; O. E. Granberg, Montreal, district deputy for Quebec. The officers of the Brockville association, nearly all of whom were present, are: A. Franklin, past-president; John Grundy, president; Charles



MR. E. J. PHILIP, President.

Bertrand, 1st vice-president; F. B. Andrews, 2nd vice-president; W. Robinson, financial secretary; James Aikens, recording secretary; John McCaw, treasurer; Stanley Beaverstock, conductor; C. Mortimer, door-keeper; Earnest Carr, E. Devine and James McRitchie, trustees.

Delegates reported as follows:

Toronto No. 1—G. C. Mooring, James Huggett, Chas. Moseley, A. M. Wickens, W. G. Blackgrove, John Fox.

Montreal No. 1—Thos. Ryan, J. J. York, J. G. Robertson.

Hamilton No. 2—Robt. Pettigrew, Geo. Mackie.

Stratford No. 3—John Hoy.

Brantford No. 4—Thos. Pilgrim, A. Ames.

London No. 5—G. B. Risler, Wm. Gerry.

Ottawa No. 7—Thos. Wensley, T. G. Johnston.

Dresden No. 8—T. M. Steeper, Wm. Jameson.

Berlin No. 9—W. J. Rhodes, Jacob Heyd.

Kingston No. 10—C. Selby, F. Simmons.

Winnipeg No. 1—G. M. Hazlett, James Robertson.

Kincardine No. 12—Percy Walker, J. Ashton.

Wiarion No. 13—J. F. Cody, Ed. Dunham.

Peterboro' No. 14—Fred Donaldson, John Morency.

Brockville No. 15—F. P. Andrews, C. Wilkinson.

Carleton Place No. 16—Jos. McKay, W. J. Griffith.

Waterloo No. 17—Chas. Uttley, Fred A. Pflug.

Ald. F. G. McCrady, a member of the association, introduced Mayor Downey, who read an address of welcome. "When Watt made his immortal discovery of the steam engine," said the Mayor, "he little thought of the vast extent to which it would develop, or that the time would come when towns and cities would be dependent on the steam engine, not merely for the comforts, but also for the necessities of life, and at times

even for their very existence. If we look at any of our great factories, with hundreds of skilled operatives, guiding and directing machinery of many different kinds, which is driven by power derived from one central source, or at the waterworks or electric light system of a great city, we shall find the steam engine the source of all the power, controlled and regulated by a faithful and energetic man, on whose skill and integrity the successful operation of the whole elaborate system depended. It was important, therefore, that competent, trustworthy engineers be employed."

The president acknowledged the welcome extended to the engineers in a brief speech, and was followed by Aldermen McCrady, O'Brien, Wright and Buell, each extending the hand of friendship to the delegates. Mr. W. F. Chapman read an address of welcome from the local association, in which the advantages of the organization were pointed out.

PRESIDENT'S ADDRESS.

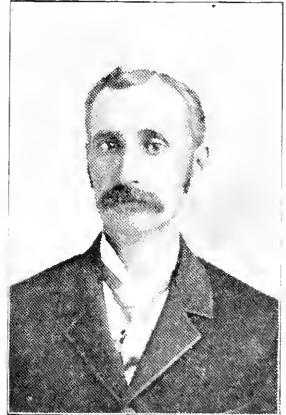
Mr. Devlin delivered the opening address as follows:

I have the honor to welcome you to this our eighth annual convention. I am aware that in selecting you as delegates our various branches have sent their best men, consequently I am confident that your deliberations will result in the advancement of our organization, and that in dealing with the various subjects brought before you, the one and only aim sought shall be the greater good of the C. A. S. E. I am sure that naught but good will prevail; indeed, such is one of the cardinal principles of our order. I need not ask for your hearty support, as this has always been given to the occupant of this chair.

The committee appointed to act jointly with the C. A. S. E. to draft a bill seeking from the Dominion Parliament a law compelling engineers to pass an examination and hold certificates of competency, met in Toronto on March 17th last. The result of the deliberations and a copy of the bill will be laid before you. As you are aware, the bill received two readings in the House of Commons, and I am assured by the delegates who had charge of the legislation at Ottawa that, were it not for the lateness of the session, there would have been every prospect of the bill becoming law. The thanks of the association are due to Mr. James Sutherland, M.P., for the kind reception of our delegates and for his earnestness in endeavoring to have the bill become law. In this connection I should say that in this movement not only are the members of our association a unit in favor of such a law, but, I might add, almost all the qualified engineers of this country are with us, as well as most of the manufacturers and steam-users.

During the past year some of our branches which had for some years shown want of vitality have been resuscitated. They are now possessed of fair membership, active and diligent in the work of the order, educational and social. London particularly is doing good work. On the whole our membership, however, shows a slight increase this year over last year. Guelph and Stratford, I am sorry to say, are not in a prosperous condition, and some effort must be made to infuse new life into these tardy branches. During the past year I can only report the establishment of one new association, that at Waterloo, Ont. It is to be hoped that during the coming year more advancement will be made in this regard. However, whilst our membership may not have materially increased in numbers, there has been great care exercised in the selection of members, and the principles of the order have been most rigidly adhered to. I am most pleased to know that in some of the lodges the work is done with great precision, the use of the book of ritual being dispensed with by many of the presiding officers. The educational work, the great feature of the organization, goes on with greatly increased vigor and benefit to the members.

During the year I had the pleasure of attending meetings at our two great centres, Montreal and Toronto. In both I was struck with the material progress visible and the facilities available to members by way of books, models, etc., whereby the educational benefits, so invaluable and important, are advanced. This feature of our association's work cannot be too highly appreciated. It may be necessary at the present convention to again take up the matter of bi-annual conventions, with a view to the curtailment of the expense necessary for our annual meeting. Steps should also be taken to arouse the engineers of the Dominion to the loss they sustain in not being of our membership. The provision made at last year's convention for the issuing of certificates of member-



MR. W. F. CHAPMAN, Vice-President.

ship has been carried out. The matter of getting up a handbook souvenir from which we expected to derive sufficient funds to meet the expenses of the convention has not taken practical shape, consequently, for this year at least, our old sources of revenue will have to be relied upon.

Our worthy secretary and myself have been in correspondence for some time past, and he will lay before you very important information on the subject, which will be of great value when the postponed work is again taken up.

Difficulties and persecution which I encountered in common with others in the same employ have rendered it impossible for me during the past seven or eight months to give the active work to the accomplishment of the souvenir scheme which I had wished. Brethren, in conclusion, I desire to express to you my deep sense of gratitude for the great honor you conferred on me a year ago when you elected me to the high and honorable position of president of this association and for the loyal manner you have stood by me. In closing, I will only add it is my heartfelt wish that your deliberations at this meeting may be so conducted towards each other that everything we shall do will redound to the benefit and honor of our good association.

The following were appointed auditors: J. Robertson, Montreal; F. Donaldson, Ottawa; Geo. Mackie, Hamilton; F. P. Anderson, Brockville.

Standing committees were appointed as follows: Credentials, J. Huggert, C. Selby, C. Uttley; constitution and by-laws, J. J. York, G. B. Risler, A. M. Wickens; mileage, Jas. Robinson, G. C. Mooring, F. M. Steeper; good of order, F. Simmons, C. Moseley, H. McKay.

Adjournment was then announced until 1.50 p.m.

AFTERNOON SESSION.

Upon resuming business reports on finance, constitution, and by-laws and credentials were presented.

"The Stationary Engineers' Act," presented to the Dominion parliament at the last session, came up for discussion. Although unsuccessful in securing the passing of the bill, it was stated to be the intention to again take up the question, and a committee for that purpose was named. At three o'clock the delegates were furnished with cabs and driven around the town. A visit of inspection was made to the Asylum for the Insane, the electric light station and the fire hall.

In the evening another session was held. Mr. A. M. Wickens gave a short talk on the C. A. S. E., and was followed by Mr. E. J. Phillip, who read an interesting paper on "Condensers, and Re-cooling Injection or Circulating Waters." A lively discussion followed the reading of the paper. Mr. G. B. Risler, of London, then read a paper on "The Steam Engine Indicator," which is unavoidably crowded out of this number.

The question of holding semi-annually meetings, referred to in the report on the Good of the Order, was discussed, with the result that the proposition was voted down. The reports of the secretary and treasurer were presented and adopted. The receipts for the year were shown to be \$431.25, and the disbursements \$164.26, leaving a balance of \$266.99. The question of publishing a souvenir was left in the hands of the secretary.

A contribution of \$10 from the Royal Oil Company, of Kingston, was acknowledged, and the secretary was voted \$25 for his services during the past year. At 10.30 adjournment was announced.

SECOND DAY.

The election of officers was the first business. The following was the result:

President—E. J. Phillip, Toronto.

Vice-president—W. F. Chapman, Brockville.

Secretary—J. C. Robertson, Montreal.

Treasurer—R. C. Pettigrew, Hamilton.

Conductor—G. B. Risler, London.

Doorkeeper—G. C. Mooring, Toronto.

Hamilton was decided upon as the next place of meeting.

Mayor Downey, on behalf of the association, presented the retiring president with a jewel. Mr. Devlin made a suitable reply.

Votes of thanks were tendered to the mayor and citizens of Brockville; to the retiring officers and the press.

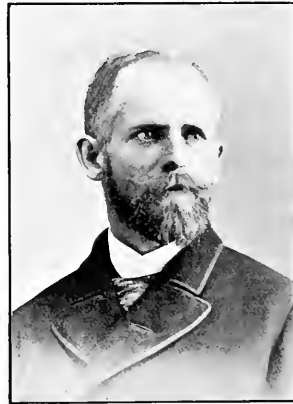
In the afternoon the delegates were given a trip up the river as far as Alexandria Bay, by the kindness of Mr. W. H. Comstock, who placed his steam yacht,

Alhani, at their disposal. The outing was thoroughly enjoyed, an hour being spent at the bay. Upon returning at seven o'clock, a short closing session was held, at which the local association was tendered a vote of thanks for the arrangements made for entertaining the delegates. Special mention was made of Mr. R. A. Bush, chairman of the local committee.

THE BANQUET.

On Friday evening a banquet was tendered the visiting delegates by the local association at St. Lawrence Hall. Mr. Chapman presided, and besides a large number of engineers, there were also present prominent citizens, including ex-mayor Derbyshire, Town Clerk McMullen, and Mr. George Nicholson, of the James Smart Company. The menu was prepared to satisfy the most fastidious tastes, and was served in first-class style.

Following the usual attention given to the bill of fare came the toast list. The Queen was duly honored, and responses made to the various toasts by the persons named below: "Canada, our Home," by Rev. J. C. Sycamore, ex-Mayor Derbyshire and Town Clerk McMullen. "Brockville, The Island City," by Mayor Downey, Ald. McCrady and O'Brien. "The Manufacturers," by Messrs. Geo. Nicholson, of James Smart Mfg. Co., and T. G. Johnston, of Ottawa. "Kindred



MR. G. B. RISLER, Conductor.

Societies," by Messrs. F. Laurence, D. Reeves, W. J. Jento and A. M. Wickens. "The Executive," by Messrs. Devlin, Phillip, Pettigrew, Robertson, Risler and Mooring. The "C. A. S. E.," by Messrs. York, Blackgrove, Fitzsimmons, Andrews and Fox. "The Press," by representatives of the Times and Recorder and the Canadian Engineer. "The Local Association," by Mr. W. F. Chapman. "The Ladies," by Mr. Robertson, of Montreal, and "The Host and Hostess," by Mr. Horace Robinson.

Vocal music was furnished during the evening by Messrs. Blackgrove and Robertson, and recitations by Mr. Daly. Many of the delegates left for their homes on the midnight train, all pleased with the Brockville convention.

THE NEW OFFICERS.

Mr. E. J. Phillip, president-elect, is a gentleman of more than ordinary ability, and under his executive management the association may be expected to enjoy a year of marked advancement. He served his apprenticeship in Galt, removing to Toronto, where he was for two years engineer for the Toronto Incandescent Light Company. He is now chief engineer for the T. Eaton Company, having charge of one of the largest isolated plants in Canada.

In the first vice-president the association has an able officer. Mr. Chapman was born near Gananoque 37 years ago, has had considerable experience in setting up boilers and engines, and installed the electric light plant at Gananoque for the Electric Light and Water Supply Company. He now holds the position of en-

gineer for the Canada Carriage Company, Brockville. Through his efforts the local association was formed.

Treasurer Pettigrew, of Hamilton, is not an active engineer, although taking a deep interest in educational matters. His energies are devoted to the coal and wood business, in which he has been quite successful.

Mr. G. B. Risler, conductor, and the author of the paper on "The Steam Engine Indicator," stands as an example of self-education. He was born in Zurich, Switzerland, in 1858, and at the age of 14 years was depending on his own resources. Having a liking for machinery, he followed the employment of fireman for a number of years, gradually working his way into the engine room. In 1884 he emigrated to Canada and served as engineer in a saw mill and woolen mill. In the year 1891 he was engaged by the Advertiser Printing Company, of London, and since that time has made great strides in educational work. Mr. Risler joined the C.A.S.E. in 1893, and last year was chosen president. He has received great benefit from the association, and vice versa. Although not yet fully master of the English language, by the assistance of the Correspondence School of Scranton he has become well posted in engineering matters, and always endeavors to combine theory with practice. He has collected a most valuable library of engineering works.

THE NATIONAL ELECTRICAL CODE.

(Concluded.)

CLASS D.—FITTINGS, MATERIALS AND DETAILS OF CONSTRUCTION.

All Systems and Voltages.

40. WIRE INSULATION.—

a. Rubber Covered—The insulating covering must be solid, at least three-sixty-fourths of an inch in thickness and covered with a substantial braid. It must not readily carry fire, must show an insulating resistance of one megohm per mile after two weeks' submersion in water at seventy degrees Fahrenheit and three days' submersion in lime water, and after three minutes' electrification with 550 volts. (See page 44.)

b. Weatherproof—The insulating covering must not support combustion, must resist abrasion, must be at least one-sixteenth of an inch in thickness, and thoroughly impregnated with a moisture repellent.

c. Flexible Cord—Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than a No. 16 B. & S. wire, and each covered by an approved insulation, and protected by a slow-burning, tough-braid outer covering.

1. Insulation for pendants under this rule must be moisture and flame proof.

2. Insulation used for cords used for all other purposes, including portable lamps and motors, must be solid, at least one-thirty-second of an inch in thickness, and must show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile after one week's submersion in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

3. The flexible conductors for portable heating apparatus, such as irons, etc., must have an insulation that will not be injured by heat, such as asbestos, which must be protected from mechanical injury by an outer, substantial, braided covering, and so arranged that mechanical strain will not be borne by electrical connection.

d. Fixture Wire—Must have a solid insulation, with a slow-burning, tough, outer covering, the whole to be at least one-thirty-second of an inch in thickness, and show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile, after one week's submersion in water at seventy degrees Fahrenheit, and after three minutes' electrification, with 550 volts.

e. Conduit Wire—Must comply with the following specifications:

1. For insulated metal conduits single wires and twin conductors must comply with section (a) of this rule.

Concentric wire must have a braided covering between the outer conductor and the insulation of the inner conductor, and, in addition, must comply with section (a) of this rule.

2. For non-insulated metal conduits single wires and twin conductors must comply with section (a) of this rule, and, in addition, have a second outer fibrous covering, at least one-thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

Concentric conductors must have a braided covering between the outer conductor and the insulation of the inner conductor, and comply with section (a) of this rule, and, in

addition, must have a second fibrous outer covering at least one-thirty-second of an inch in thickness, and sufficiently tenacious to withstand the abrasion of being hauled through the metal conduit.

41. INTERIOR CONDUITS.—(For wiring rules, see Nos. 24 and 25.)

a. Each length of conduit, whether insulated or uninsulated, must have the maker's name or initials stamped in the metal, or attached thereto in a satisfactory manner, so that the inspectors can readily see the same.

Insulated Metal Conduits:

b. The metal covering, or pipe, must be at least equal in thickness, or of equal strength to resist penetration by nails, etc., as the ordinary commercial form of gas pipe of same size.

c. Must not be seriously affected externally by burning out a wire inside the tube when the iron pipe is connected to one side of the circuit.

d. Must have the insulating lining firmly secured to the pipe.

e. The insulating lining must not crack or break when a length of the conduit is uniformly bent at temperature of 212 degrees Fahrenheit to an angle of ninety degrees, with a curve having a radius of fifteen inches, for pipes of one inch and less, and fifteen times the diameter of pipe for larger pipes.

f. The insulating lining must not soften injuriously at a temperature below 212 degrees Fahrenheit, and must leave water in which it has been boiled practically neutral.

g. The insulating lining must be at least one-thirty-second of an inch in thickness, and the materials of which it is composed must be of such a nature as will not have a deteriorating effect on the insulation of the conductor, and be sufficiently tough and tenacious to withstand the abrasion test of drawing in and out of same long lengths of conductors.

h. The insulating lining must not be mechanically weak after three days' submersion in water, and, when removed from the pipe entire, must not absorb more than ten per cent. of its weight of water during 100 hours of submersion.

i. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve in the inner edge of any elbow not to be less than three and one-half inches. Must have not more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

Uninsulated Metal Conduits:

j. Plain iron or steel pipes of equal thickness, or of equal strength, to resist penetration of nails, etc., as the ordinary commercial form of gas pipes of the same size, may be used as conduits, provided their interior surfaces are smooth and free from burrs; pipe to be galvanized, or the interior surfaces coated or enamelled to prevent oxidation with some substance which will not soften so as to become sticky and prevent wire from being withdrawn from the pipe.

k. All elbows must be made for the purpose, and not bent from lengths of pipe. The radius of the curve of the inner edge of any elbow, not to be less than three and one-half inches. Must have not more than the equivalent of four quarter bends from outlet to outlet, the bends at the outlets not being counted.

42. WOODEN MOULDINGS.—(For wiring rules, see No. 24.)

a. Must have, both outside and inside, at least two coats of waterproof paint, or be impregnated with a moisture repellent.

b. Must be made of two pieces, a backing and a capping so constructed as to thoroughly incase the wire, and provide a one-half inch tongue between the conductors, and a solid backing, which, under grooves, shall not be less than three-eighths of an inch in thickness, and must afford suitable protection from abrasion.

It is recommended that only hardwood moulding be used.

48. SWITCHES.—(See Nos. 17 and 22.)

a. Must be mounted on non-combustible, non-absorptive, insulating bases, such as slate or porcelain.

b. Must have carrying capacity sufficient to prevent undue heating.

c. Must, when used for service switches, indicate, on inspection, whether the current be "on" or "off."

d. Must be plainly marked where it will always be visible, with the name of the maker and the current and voltage for which the switch is designed.

e. Must, for constant potential systems, operate successfully at fifty per cent. overload in amperes, with twenty-five per cent. excess voltage under the most severe conditions they are liable to meet with in practice.

f. Must, for constant potential systems, have a firm and secure contact; must make and break readily, and not stop when motion has once been imparted by the handle.

g. Must, for constant current systems, close the main circuit and disconnect the branch wires when turned "off"; must be so constructed that they shall be automatic in action, not stopping between points when started, and must prevent an arc between the points under all circumstances. They must indicate, upon inspection, whether the current be "on" or "off."

44. CUT-OUTS AND CIRCUIT BREAKERS.—(For installation rules, see Nos. 17 and 21.)

a. Must be supported on bases of non-combustible, non-absorptive insulating material.

b. Cut-outs must be provided with covers, when not arranged in approved cabinets, so as to obviate any danger of the melted fuse metal coming in contact with any substance which might be ignited thereby.

c. Cut-outs must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuits with fuses rated at 50 per cent. above and with a voltage 25 per cent. above the current and voltage for which they are designed.

d. Circuit-breakers must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuits when set at 50 per cent. above the current, and with a voltage 25 per cent. above that for which they are designed.

e. Must be plainly marked where it will always be visible, with the name of the maker, and current and voltage for which the device is designed.

45. FUSES.—(For installation rules, see Nos. 17 and 21.)

a. Must have contact surfaces or tips of harder metal having perfect electrical connection with the fusible part of the strip.

b. Must be stamped with about eighty per cent. of the maximum current they can carry indefinitely, thus allowing about 25 per cent. overload before fuse melts.

With naked open fuses, of ordinary shapes and not over 500 amperes capacity, the maximum current which will melt them in about five minutes may be safely taken as the melting point, as the fuse practically reaches its maximum temperature in this time. With larger fuses a longer time is necessary.

Inclosed fuses where the fuse is often in contact with substances having good conductivity to heat, and often of considerable volume, require a much longer time to reach a maximum temperature on account of the surrounding material which heats up slowly. This data is given to facilitate testing.

c. Fuse terminals must be stamped with the maker's name, initials, or some known trade mark.

46. CUT-OUT CABINETS.—

a. Must be so constructed, and cut-outs so arranged, as to obviate any danger of the melted fuse metal coming in contact with any substance which might be ignited thereby.

A suitable box can be made of marble, slate or wood, strongly put together, the door to close against a rabbit so as to be perfectly dust tight, and it should be hung on strong hinges and held closed by a strong hook or catch. If the box is wood the inside should be lined with sheets of asbestos board about one-sixteenth of an inch in thickness, neatly put on and firmly secured in place by shellac and tacks. The wires should enter through holes bushed with porcelain bushings; the bushings tightly fitting the holes in the box, and the wires tightly fitting the bushings (using tape to build up the wire, if necessary) so as to keep out the dust.

47. SOCKETS.—(See No. 27.)

a. No portion of the lamp socket, or lamp base, exposed to contact with outside objects, must be allowed to come in electrical contact with either conductor.

b. Must, when provided with keys, comply with the requirements for switches. (See No. 43.)

48. HANGER-BOARDS.—

a. Hanger-boards must be so constructed that all wires and current carrying devices thereon shall be exposed to view and thoroughly insulated by being mounted on a non-combustible, non-absorptive insulating substance. All switches attached to the same must be so constructed that they shall be automatic in their action, cutting off both poles to the lamp, not stopping between points when started and preventing an arc between points under all circumstances.

49. ARC LAMPS.—(For installation rules, see No. 19.)

a. Must be provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

b. Must be carefully insulated from the circuit in all their exposed parts.

c. Must, for constant current systems, be provided with an approved hand switch, also an automatic switch that will shut the current around the carbons, should they fail to feed properly.

The hand switch to be approved, if placed anywhere except on the lamp itself, must comply with requirements for switches on hanger-boards, as laid down in Rule 48.

50. SPARK ARRESTERS.—(See No. 19c.)

a. Spark arresters must so close the upper orifice of the globe that it will be impossible for any sparks thrown off by the carbons to escape.

51. INSULATING JOINTS.—(See No. 26a.)

a. Must be entirely made of material that will resist the action of illuminating gases, and will not give way or soften under the heat of an ordinary gas flame or leak under a moderate pressure. They shall be so arranged that a deposit of moisture will not destroy the insulating effect, and shall have an insulating resistance of at least 250,000 ohms between the gas-pipe attachments, and be sufficiently strong to resist the strain they will be liable to be subjected to in being installed.

b. Insulating joints having soft rubber in their construction will not be approved.

52. RESISTANCE BOXES AND EQUALIZERS.—(For installation rules, see No. 4.)

a. Must be equipped with metal, or with other non-combustible frames.

The word "frames," in this section relates to the entire case and surroundings of the rheostat, and not alone to the upholding supports.

53. REACTIVE COILS AND CONDENSERS.—

a. Reactive coils must be made of non-combustible material, mounted on non-combustible bases and treated, in general, like sources of heat.

b. Condensers must be treated like apparatus operating with equivalent voltages and currents. They must have non-combustible cases and supports, and must be isolated from all combustible materials and, in general, treated like sources of heat.

54. TRANSFORMERS.—(For installation rules, see Nos. 11 and 33.)

a. Must not be placed in any but metallic or other non-combustible cases.

55. LIGHTNING ARRESTERS.—(For installation rules, see No. 5.)

a. Must be mounted on non-combustible bases, and must be so constructed as not to maintain an arc after the discharge has passed, and must have no moving parts.

CLASS E.—MISCELLANEOUS.

56. INSULATION RESISTANCE.—

The wiring in any building must test free from grounds, i.e., the complete installation must have an insulation between conductors and between all conductors and the ground (not including attachments, sockets, receptacles, etc.) of not less than the following:

Up to	5 amperes	4,000,000
"	10 "	2,000,000
"	25 "	800,000
"	50 "	400,000
"	100 "	200,000
"	200 "	100,000
"	400 "	50,000
"	800 "	25,000
"	1,000 "	and over 12,500

All cut-outs and safety devices in place in the above.

Where lamp sockets, receptacles and electroliers, etc., are connected, one-half of the above will be required.

57. PROTECTION AGAINST FOREIGN CURRENTS.—

a. Where telephone, telegraph or other wires, connected with outside circuits, are bunched together within any building, or where inside wires are laid in conduits or ducts with electric light or power wires, the covering of such wires must be fire-resisting, or else the wires must be enclosed in an air-tight tube or duct.

b. All aerial conductors and underground conductors, which are directly connected to aerial wires, connecting with telephone, telegraph, district messenger, burglar-alarm, watch-clock, electric time and other similar instruments, must be provided near the point of entrance to the building with some approved protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest any abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor charged with a relatively high pressure.

Protectors must have a non-combustible insulating base, and the cover to be provided with a lock similar to the lock now placed on telephone apparatus or some equally secure fastening, and to be installed under the following requirements:

1. The protector to be located at the point where the wires enter the building, either immediately inside or outside of the same. If outside, the protector to be enclosed in a metallic, waterproof case.

2. If the protector is placed inside of building, the wires of the circuit from the support outside to the binding posts of the protector to be of such insulation as is approved for service wires of electric light and power (see No. 40a) and the holes through the outer wall to be protected by bushing the same as required for electric light and power service wires.

3. The wire from the point of entrance to the protector to be run in accordance with rules for high potential wires, i.e., free of contact with building and supported on non-combustible insulators.

4. The ground wire shall be insulated, not smaller than No. 16 B. & S. gauge copper wire. This ground wire shall be kept at least three inches from all conductors, and shall never be secured by uninsulated, double-pointed tacks, and must be run in as straight a line as possible to the ground connection.

5. The ground wire shall be attached to a water pipe, if possible, otherwise may be attached to a gas pipe. The ground wire shall be carried to, and attached to, the pipe outside of the first joint or coupling inside the foundation walls, and the connection shall be made by soldering, if possible. In the absence of other good ground, the ground shall be made by means of a metallic plate or a bunch of wires buried in a permanently moist earth.

58. ELECTRIC GAS LIGHTING.—

Where electric gas lighting is to be used on the same fixture with the electric light:

a. No part of the gas piping or fixture shall be in electric connection with the gas lighting circuit.

b. The wires used with the fixtures must have a non-inflammable insulation, or, where concealed between the pipe and shell of the fixture, the insulation must be such as required for fixture wiring for the electric light.

c. The whole installation must be free from "grounds."

d. The two installations must test perfectly free from connection with each other.

59. SOLDERING FLUID.—

a. The following formula for soldering fluid is suggested:

Saturated solution of zinc chloride	5 parts.
Alcohol	4 parts.
Glycerine	1 part.

CLASS F.—MARINE WORK.

60. GENERATORS.—

a. Must be located in a dry place.

b. Must have their frames insulated from their bed-plates.

c. Must each be provided with a waterproof cover.

d. Must each be provided with a name-plate, giving the maker's name, the capacity in voltage and amperes and normal speed in revolutions per minute.

61. WIRES.—

a. Must have an approved insulating covering.

The insulation for all conductors, except for portables, to be approved, must be at least one-eighth inch in thickness and be

covered with a substantial waterproof and flameproof braid. The physical characteristics shall not be affected by any change in temperature up to 200 degrees Fahrenheit. After two weeks' submersion in salt water at 70 degrees Fahrenheit it must show an insulation resistance of one megohm per mile after three minutes' electrification, with 550 volts.

b. Must have no single wire larger than No. 12 B. & S. Wires to be stranded when greater carrying capacity is required. No single solid wire smaller than No. 14 B. & S., except in fixture wiring, to be used.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

c. Must be supported in approved moulding, except at switchboards and portables.

Special permission may be given for deviation from this rule in dynamo rooms.

d. Must be bushed with hard rubber tubing one-eighth inch in thickness when passing through beams and non-water-tight bulkheads.

e. Must have when passing through water-tight bulkheads and through all decks, a metallic stuffing tube lined with hard rubber. In case of deck tubes they shall be boxed near deck to prevent mechanical injury.

f. Splices or taps in conductors must be avoided as far as possible. Where it is necessary to make them, they must be so spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered, to insure preservation, covered with an insulating compound equal to the insulation of a wire, and further protected by a waterproof tape. The joint must then be coated or painted with a waterproof compound.

62. PORTABLE CONDUCTORS—

a. Must be made of two stranded conductors, each having a carrying capacity equivalent to not less than No. 14 B. & S. wire, and each covered with an approved insulation and covering.

Where not exposed to moisture or severe mechanical injury, each stranded conductor must have a solid insulation at least one-thirty-second of an inch in thickness, and must show an insulation resistance between conductors, and between either conductor and the ground, of at least one megohm per mile after one week's submersion in water at seventy degrees Fahrenheit and after three minutes' electrification, with 500 volts, and be protected by a slow-burning, tough-braided outer covering.

Where exposed to moisture and mechanical injury—as for use on decks, holds and fire-rooms—each stranded conductor shall have a solid insulation, to be approved, of at least one-thirty-second of an inch in thickness and protected by a tough braid. The two conductors shall then be stranded together, using a jute filling. The whole shall then be covered with a layer of flax, either woven or braided, at least one-thirty-second of an inch in thickness, and treated with a non-inflammable, waterproof compound. After one week's submersion in water at seventy degrees Fahrenheit, with 550 volts and a three minutes' electrification, must show an insulation between the two conductors, or between either conductor and the ground, of one megohm per mile.

63. BELL OR OTHER WIRES—

a. Shall never be run in same duct with lighting or power wires.

64. TABLE OF CAPACITY OF WIRES—

B. & S. G.	Area Actual Sq. In.	No. of Strands	Size of Strands B. & S. G.	Amperes.
19	1,988	..	..	..
18	1,674	..	..	..
17	2,748	..	..	..
16	2,583	..	..	..
15	3,257	..	..	..
14	4,107	..	..	..
13	6,510	..	..	..
12	9,019	7	19	24
11	11,368	7	18	25
10	14,136	7	17	26
9	18,684	7	16	27
8	20,799	7	15	28
7	26,859	10	14	30
6	36,922	19	13	32
5	49,077	37	12	35
4	66,088	37	11	37
3	75,776	37	10	39
2	92,161	41	9	41
1	124,022	41	8	43
..	157,563	61	7	45
..	198,077	61	6	47
..	250,227	61	5	49
..	319,387	91	4	51
..	373,777	91	3	53
..	443,533	127	2	55

When greater conducting area than that of 12 B. & S. G. is required, the conductor shall be stranded in a series of 7, 19, 37, 61, 91 or 107 wires, as may be required; the strand consisting of one central wire, the remainder laid around it concentrically, each layer to be twisted in the opposite direction from the preceding.

65. SWITCHBOARDS—

a. Must be made of non-combustible, non-absorptive, insulating material, such as marble or slate.

b. Must be kept free from moisture, and must be located so as to be accessible from all sides.

c. Must have a main switch, main cut-out and ammeter for each generator.

Must also have a voltmeter and ground detector.

d. Must have a cut out and switch for each side of each circuit leading from board.

66. RESISTANCE BOXES—

a. Must be made of non-combustible material.

b. Must be located on switchboard or away from combustible material. When not placed on switchboard they must be mounted on non-inflammable, non-absorptive insulating material.

c. Must be so constructed as to allow sufficient ventilation for the uses to which they are put.

67. SWITCHES—

a. Must have non-combustible, non-absorptive, insulating bases.

b. Must operate successfully at fifty per cent. overload in amperes with twenty-five per cent. excess voltage under the most severe conditions they are liable to meet with in practice, and must be plainly marked where it will always be visible, with the name of the maker and the current and voltage for which the switch is designed.

c. Must be double-pole when circuits which they control supply more than six 16-candle-power lamps or their equivalent.

d. When exposed to dampness, they must be enclosed in a water-tight case.

68. CUT-OUTS—

a. Must have non-combustible, non-absorptive insulating bases.

b. Must operate successfully, under the most severe conditions they are liable to meet with in practice, on short circuit with fuse rated at fifty per cent. above, and with a voltage twenty-five per cent. above the current and voltage they are designed for, and must be plainly marked where they will always be visible with the name of the maker and current and voltage for which the device is designed.

c. Must be placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller).

d. In places, such as upper decks, holds, cargo places and fire-rooms a water-tight and fireproof cut-out may be used, connecting directly to mains when such cut-out supplies not more than six 16-candle-power lamps or their equivalent.

e. When placed anywhere except on switchboards and certain places, as cargo spaces, holds, fire-rooms, etc., where it is impossible to run from centre of distribution, they shall be in a cabinet lined with fire-resisting materials.

f. Except for motors, search-lights and diving lamps shall be so placed that no group of lamps, requiring a current or more than six amperes, shall ultimately be dependent upon one cut-out.

A single-pole covered cut-out may be placed in the moulding when same contains conductors supplying current for not more than two 16-candle-power lamps or their equivalent.

69. FIXTURES—

a. Shall be mounted on blocks made from well-seasoned lumber treated with two coats of white lead or shellac.

b. Where exposed to dampness, the lamp must be surrounded by a vaporproof globe.

c. Where exposed to mechanical injury, the lamp must be surrounded by a globe protected by a stout wire guard.

d. Shall be wired with same grade of insulation as portable conductors which are not exposed to moisture or mechanical injury.

70. SOCKETS—

a. No portion of the lamp socket or lamp base exposed to contact with outside object shall be allowed to come into electrical contact with either of the conductors.

71. WOODEN MOULDING—

a. Must be made of well-seasoned lumber, and be treated inside and out with at least two coats of white lead or shellac.

b. Must be made of two pieces, a backing and a capping, so constructed as to thoroughly incase the wire and provide a one-half-inch tongue between the conductors, and a solid backing which, under grooves, shall not be less than three-eighths inch in thickness.

c. Where moulding is run over rivets, beams, etc., a backing strip must first be put up and the moulding screwed to this.

d. Capping must be secured by brass screws.

72. MOTORS—

a. Must be wired under the same precautions as with a current of same volume and potential for lighting. The motor and resistance box must be protected by a double-pole cut-out and controlled by a double-pole switch, except in cases where one-quarter horse-power or less is used.

The leads or branch circuits should be designed to carry a current at least fifty per cent. greater than that required by the rated capacity of the motor to provide for the inevitable overloading of the motor at times.

b. Must be thoroughly insulated. Where possible, should be set on base frames made from filled, hard, dry wood and raised above surrounding deck. On hoists and winches they shall be insulated from bed-plates by hard rubber, fibre or similar insulating material.

c. Shall be covered with a waterproof cover when not in use.

d. Must each be provided with a name-plate giving maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formulae and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the elementary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formulae. Many of our ablest and ablest engineering works and publications from time to time contain formulae that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the program outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obscure and difficult formulae can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CYLINDRICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formulae and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE V.]

SAFETY VALVE CALCULATIONS.

ALL boilers should be fitted with two safety valves, one of which should be a lock-up valve, and set by the Boiler Inspector under whose immediate control it is.

The Canada Steamboat Act provides that every safety valve must have a lift equal to at least one-fourth of its diameter; the openings for the passage of steam to and from the valve must each have an area not less than the area of the valve, as must also all waste steam pipes, etc., and the area of a safety valve must equal one-half inch for each square foot of grate surface in or under the boiler.

LEVER TYPE.

Find the diameter of a safety valve required for a boiler whose grate bars are 5 feet long and furnace 3 feet wide.

We first find number of square feet of grate surface; then divide by 2, which gives area of valve in inches; square root of area divided by .7854 equals diameter.

$$\begin{aligned} \text{then } \frac{L \times W}{2} &= A \\ \text{and } \sqrt{\frac{A}{.7854}} &= D. \end{aligned}$$

Where L equals length of grate bars,

W equals width of furnace,

A equals area of valve in inches,

D equals required diameter of valve.

$$\begin{aligned} \frac{5 \times 3}{2} &= 7.5 \text{ sq. inches.} \\ 7.5 \div .7854 &= 9.549. \end{aligned}$$

Square root of 9.549 equals 3.09 inches; then required diameter of valve is 3.09 inches, say 3 1/8 inches.

Example (2): What weight is required to be placed 2 inches from the end of a safety valve lever to equal a boiler pressure of .50 pounds to the square inch, the diameter of valve being 3 1/8 inches, the distance from fulcrum to valve 6 inches, and total length of lever from fulcrum 16 inches? The weight of valve and stem is 15 pounds, and effective moment of lever 80 inch pounds.

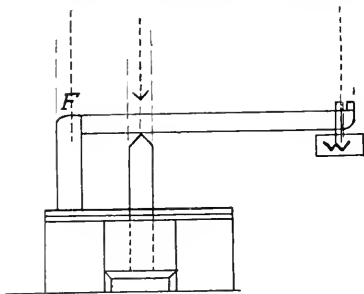


Fig. 1

Since the steam pressure within the boiler and consequently pressing against the lower face of the valve and trying to unseat it, equals so many pounds per square inch, we must first find the

area of the valve in square inches, to ascertain the whole force tending to raise the valve, but since the weight of the valve, spindle and lever acts downwards and against the upward pressure of the steam, we must make allowance for this, and the remaining force is that which we have to counteract by weight.

In diagram No. 1 F is the fulcrum, V is the point where pressure is exerted, W is the weight, FV is 6 inches, VW is 10 inches, and FW is 16 inches.

The principle of the lever is: The weight or force multiplied by its distance from the fulcrum is equal to the weight or pressure on the valve multiplied by its distance from the fulcrum,

$$\text{or, } W \times FW = V \times FV.$$

But the steam pressure has, in addition to the actual weight of W, also to overcome the moment of the lever, which is found by weighing the lever and finding how far its balancing point is from F; then this distance multiplied by its weight is the effective moment of the lever, which we will call A.

$$\text{Then } W \times FW + A = V \times FV;$$

that is, the total force at work keeping the valve down is equal to the force or pressure endeavoring to lift it off its seat.

In accordance, then, with these principles, we get the following rules:

(1) Find the area of the valve and multiply it by the pressure per square inch.

(2) From the product take the weight of the valve and stem; the remainder is the V of the formula.

(3) Multiply "the remainder by the distance from the fulcrum to the valve," FV, then subtract the moment of the lever, and divide by "the distance from the fulcrum to the weight," FW, found by adding "the distance from the fulcrum to the valve" to that "from the valve to the weight."

$$3.125 \times 3.125 \times .7854 = 7.67, \text{ area of valve.}$$

$$7.67 \times .50 = 383.50, \text{ pressure against valve.}$$

$$383.5 - 15 = 368.5, \text{ effective upward weight.}$$

$$368.5 \times 6 \text{ FV} = 2211.0, \text{ effective moment lifting lever.}$$

$$2211 - 80 \text{ (effective moment of lever acting downwards)} = 2211 - 80 = 2131.$$

$$2131 \div 16 = 133.2, \text{ required weight of W.}$$

NOTE: For extreme accuracy it is necessary to take note of the weight of the valve and its parts, and also of the moment of the lever; but in a great many cases this is entirely omitted. Then a question of this kind becomes simplified thus:

$$W = \frac{\text{area} \times \text{pressure} \times FV}{FW}$$

TO GRADUATE A SAFETY VALVE LEVER.

We have a safety valve 4 inches in diameter, and spindle presses against a point in the lever that is 4 inches from the fulcrum; how far must a weight of 120 pounds be placed from the fulcrum to equal a boiler pressure of 60 pounds to the square inch, when the valve weighs 8 pounds and effective moment of the lever is 50 inch pounds. Also give the graduation marks on the lever for 40 and 50 pounds pressure with the same weight.

$$\text{Formula } V = \frac{\text{area} \times \text{pressure} - 8}{FW}$$

$$FW = \frac{V \times FV - 50}{W}$$

In this question we require to find distance, FW. We first find area of valve; multiply this by pressure per square inch, and then subtract weight of valve and parts bearing downward to get total

effective upward pressure; this equals V of formula. Now multiply total upward pressure by distance fulcrum to valve and subtract effective moment of lever; result, divided by weight, equals distance fulcrum to weight.

$$\begin{aligned} 4 \times 4 &= 16 \times .7854 = 12.5664, \text{ area valve.} \\ 12.5664 \times 60 &= 753.98, \text{ total pressure.} \\ 753.98 - 8 &= 745.98, V, \text{ total effective pressure.} \\ 745.98 \times 4 &= 2983.92, \text{ total moment of valve.} \\ 2983.92 - 50 &= 2933.92, \text{ total effective moment of valve.} \\ 2933.92 \div 120 &= 24.45 \text{ inches distance FW.} \end{aligned}$$

Since the distance FW = 24.45 inches for a pressure of 60 pounds to the square inch, we can find what distance represents a pressure of 10 pounds by dividing this distance by 6, the number of times 10 is contained in 60.

$$24.45 \div 6 = 4.07.$$

Then for each additional 10 pounds pressure we require to move the weight a distance of 4.07 inches further from the fulcrum, and to find the distance from the fulcrum equal to a pressure of 40 pounds, this distance multiplied by 4 = FW; therefore,

$$\text{FW at 50 pounds pressure} = 4.07 \times 5 = 20.35 \text{ ins.}$$

$$\text{FW at 40 pounds pressure} = 4.07 \times 4 = 16.28 \text{ ins.}$$

Required to find distance from fulcrum to valve, boiler pressure being 50 pounds to square inch; diameter of valve, 4 inches; weight of valve and spindle, 10 pounds; distance valve to weight, 12 inches, and weight 150 pounds; moment of valve lever, 40 inch pounds.

Formula:

$$\text{FV} = \frac{VW \times W + \text{moment}}{V}$$

$$4^2 \times .7854 = 12.5664 \text{ square inches.}$$

$$12.5664 \times 50 = 628.32, \text{ total pressure.}$$

$$628.32 - 10 = 618.32, \text{ total effective upward pressure, or } V.$$

$$12 \times 150 = 1800 \text{ pounds.}$$

$$1800 + 40 = 1840, \text{ total weight acting downwards at } V.$$

$1840 \div 618.32 = 2.975$ inches distance FV; or distance FV is nearly 3 inches.

SUMMARY.

TO FIND effective moment of lever, multiply weight of lever by distance from its balancing point or centre of gravity to fulcrum, and divide by distance from centre of valve stem to fulcrum. Result will be effective moment of lever in inch pounds, or the weight required to raise valve off its seat with nothing but lever holding against steam.

TO FIND actual effective weight of ball, divide weight of ball by distance from fulcrum to valve stem, and multiply quotient by distance from ball to fulcrum.

TO FIND length of lever, add together effective moment of lever and weight of valve and stem, and subtract from total pressure acting upwards against valve. Divide remainder by weight of ball, and multiply quotient by distance from stem to fulcrum.

TO FIND weight of ball, add together the effective moment of lever and weight of valve and stem, and subtract this sum from total pressure against valve at blowing-off point. Multiply remainder by distance from fulcrum to stem, and divide quotient by length of lever from fulcrum to weight.

TO FIND diameter of valve to blow off at given pressure, add together effective moment of lever, weight of valve and stem, and effective weight of ball. Divide this sum by gauge pressure, and result will be required area of valve.

Square root of area divided by .7854 equals diameter.

TO FIND pressure at which a boiler will blow off, add together effective moment of lever, weight of valve and stem, and effective weight of ball. Divide this sum by area of valve in square inches. Result will be gauge pressure at which safety valve will act.

FUNDAMENTAL PRINCIPLES OF ELECTRIC ENERGY.

COMMON UNITS OF MEASURE.

The units commonly met with by engineers in the study of the principles underlying the generation, transmission and use of electricity are the volt, ampere, ohm and watt.

In diagram No. 1 A is a dynamo or electric battery, and the source of electric energy, and the purpose of which is to produce a difference in potential between the terminals B and B₁. This difference in potential is measured in volts, and we say that between the terminals B and B₁ there exists an electric potential or pressure of so many volts, written symbolically (E.M.F.)

Let us now suppose that a difference in potential exists between B and B₁, and that B is the point of higher pressure; if we connect B and B₁ together by a substance capable of conducting electricity, there will be a flow from B to B₁. This flow of electricity is known as a current and measured as amperes.

The rate at which current will flow from B to B₁ when joined together by a conductor as at C depends upon following conditions: 1st, upon the difference in pressure or electric potential between B and B₁; 2nd, upon cross section or area of conductor

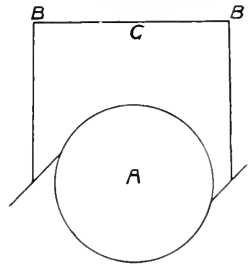


Fig. 1

C, and upon length of C and nature of material of which C is composed; or, in other words, we may say that the rate at which current will flow through conductor C depends upon the difference in pressure and upon resistance offered by C to current.

Therefore, the greater the difference in potential the greater the current.

When a current flows through a conductor there is a loss in potential or voltage caused by the resistance of the conductor. This resistance is measured in ohms, and consequently a conductor is said to have a resistance of so many ohms.

When a difference in potential exists between B and B₁, but no connection between them, there is no flow of current through the dynamo or generator A, and therefore no work will be done by it. But if conductor C is connected to terminals B and B₁, current will at once begin to flow, and A will be compelled to do work to keep up the flow. The rate at which this work will be done will depend upon difference in potential between terminals B and B₁, and upon quantity of current flowing through the circuit. This then becomes the electrical energy or rate of doing work, and the electric unit of work or energy is the watt, and, in accordance with above, equals the volts multiplied by the amperes, or by the potential in volts multiplied by current in amperes.

The watt, then, is the product of one volt and one ampere, and in energy or work is equal to $\frac{1}{746}$ h.p., or 746 watts are equivalent to the mechanical force necessary to raise 550 pounds one foot high in one second, or 33,000 pounds one foot high in one minute.

The kilo-watt, as the name implies, equals 1,000 watts.

The symbols commonly used in formula to represent the units above described are as follows:

E, or E.M.F. equals electro motive force or volts.

C, the current or amperes.

R, the resistance or ohms.

W, or watts, represents the electrical energy.

K.W. represents kilo-watts.

(To be Continued.)

TRADE NOTES.

The Goldie & McCulloch Company, of Galt, have installed new engines for the Oshawa Malleable Iron Works Company.

The Canadian General Electric Company are installing an 150 light incandescent plant for the estate of Ross Bios., Buckingham, Que.

The New York offices of the Western Electric Company have been removed to their new building at 57-67 Bethune street. The retail store in the Thames street building is still retained.

The Rogers Electric Company, of London, Ont., are installing electric lights in the Anderson Furniture Company's factory, Woodstock, under sub-contract from the Stevens Manufacturing Company.

We are advised that the Montreal Street Railway Company, after a careful investigation of the merits of the various types of motors operated on their roads, have placed an order for fifty additional G.E. 1,000 motors with the Canadian General Electric Company.

The Toronto Electric Motor Company have recently placed a 600 incandescent light plant in the Methodist Book & Publishing Company's building, Toronto. The dynamo is direct connected with Ideal engine, manufactured by Goldie & McCulloch, of Galt.

The Ottawa Car Company have received an order from the Hamilton, Grimsby and Beamsville Railway Company for two cars of new design, to be 50 feet in length, with baggage and mail compartments. These are said to be the largest street railway cars yet manufactured in Canada.

The Canadian General Electric Company have received an order for a 2,000 light, single phase alternator for Revelstoke, B. C. This machine, which will be of their standard iron-clad revolving armature type, compounded to secure automatic regulation, will be used to supply incandescent lighting in Revelstoke and vicinity.

The Toronto Electrical Works has been reorganized and is now known as the Toronto Electrical Works Co., Limited. The company's offices and works have also been removed to commodious premises at 40 to 42 Adelaide Street West. Simultaneously with the above mentioned changes, the company have issued a new and comprehensive catalogue.

ELECTRIC RAILWAY DEPARTMENT.

AN ESTEEMED STREET RAILWAY MANAGER.

As a result of the control of the Birmingham street railway passing into the hands of Canadian capitalists, this country is to lose one of its most popular railway managers, in the person of Mr. Granville C. Cunningham, manager of the Montreal street railway. In company with Mr. Ross, Mr. Cunningham visited England recently, when the negotiations for securing the franchise of the Birmingham road were pending, and now comes the announcement that he has been appointed manager of the Birmingham system, while he is succeeded as manager of the Montreal road by Mr. F. L. Wanklyn, who recently took charge of the Toronto railway system.

Mr. Cunningham's removal to England is much regretted in street railway circles, not alone by his confreres in other cities, but by the employees under him. As an evidence of this the employees of the Montreal

severance of your connection with the company a personal loss to all of us.

While moved with feelings of regret that the relationship between us is about to cease, we cannot but feel gratified that you have been called upon to assume a charge of greater importance and responsibility, and in this and every future position that you may be called upon to fill, we offer to you our best wishes, and we pray that long life, health and happiness may be granted to both Mrs. Cunningham and yourself.

With this expression of our warmest feelings and regrets at your departure, we beg you to accept the accompanying remembrance.

Signed on behalf of the officers and employees of the Montreal Street Railway Company.

The address was accompanied by a magnificent silver tea and coffee set and a beautifully mounted cane, accompanied by an illuminated address, which was framed and contained the portrait of the recipient.

Mr. Cunningham, in replying, said the ovation was as unexpected as it was complimentary, and he thanked them all from the bottom of his heart. He referred to the reputation which the employees of the Montreal street railway enjoyed. It was only the other day, he said, that a gentleman from England had referred to the excessive kindness and politeness of the officials to the travelling public.



MR. GRANVILLE C. CUNNINGHAM.

street railway assembled at the Monument National Hall on the 20th ultimo. There were present Messrs. Duncan McDonald, superintendent; F. P. Brothers, superintendent of construction; J. S. Vindin, engineer; M. Watt, secretary; N. Graburn, assistant superintendent; L. Landers, cashier; T. Casey, storekeeper; A. Alexander, engineer of power house; W. G. Ross, controller; H. R. Lockhart, electrician; Dr. Mount, medical officer to the company; George Strubbe, claims agent; D. McQuaid, foreman carpenter; H. Taylor, mechanical superintendent, and probably 800 conductors, motormen and other employees. Mr. McDonald read the following address:

GRANVILLE C. CUNNINGHAM, ESQ:

DEAR SIR,—We, the officers and employees of the Montreal Street Railway Company, have, with feelings of deepest regret, heard the announcement of your resigning the management of the company, and feel that we cannot permit the occasion to pass without giving expression to the deep sense of the loss which we are about to sustain. In our past connection we have always experienced at your hands that just and fair treatment, patient consideration and courtesy which have won for you our esteem and regard, and made the

ROLLER BEARINGS FOR ELECTRIC TRACTION.

"ROLLER BEARINGS" was the title of a paper read before the British Association for the Advancement of Science at its recent convention in Toronto, by Mr. W. Bayley Marshall, M. Inst. C. E. The paper strongly advocated the employment of roller bearings for electric railways, and contained points of interest to railway people. Among the chief advantages claimed for these bearings by Mr. Marshall are great reduction in starting effort, decreased traction and revolving effort, and economy in lubrication.

Concerning their adaptability for electric traction he says: "In the case of electrical traction the reduced starting effort is of almost vital importance, as not only does it effect a very considerable saving in electrical output, but also greatly reduces the serious rush of current through the motors at the moment of starting, which rush is due to the fact that the motors and load have to be started at the same moment, with results most detrimental to the life of the motor. If the necessary effort can be materially reduced, there will be a large economy effected under the head of "Maintenance of Motors." The Liverpool overhead railway made their first trials with these roller bearings some two years ago, and are now gradually fitting them to the whole of their rolling stock, as they find that since their introduction they have, with a slight modification of their motors, been enabled to run three instead of two coach trains, the extra coach being without motors, thus increasing the carrying capacity of their trains by 50 per cent. The contention that the application of roller bearings in the case of electrical traction will show a great economy under the head of "Maintenance of Motors" has been amply borne out by the experience gained at Liverpool."

In describing the patent for roller bearings taken out

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No. 10.

**ELECTRICAL POWER TRANSMISSION
PLANT AT THREE RIVERS,
QUEBEC.**

BY H. R. LEYDEN.

THE first long distance electrical power transmission plant to be installed in Canada has now been in operation for six months, with most satisfactory results both from engineering and financial standpoints. This plant

power is applied to the old system with surprisingly few changes in the old method of distribution.

The old plant consisted of two single-phase alternators of 1,500 and 750 incandescent lamps capacity, and of two series arc dynamos, one of 35 and the other of 50 lamps capacity. All the dynamos were belted directly to high-speed steam engines. There was also a suitable boiler plant, using bituminous coal for fuel. In connection with the electric lighting plant, there was a pump-



NO. 1.—THE WATER FALL.

has been installed by the North Shore Power Company, and transmits power from the water fall at Grande Chute, on the Batiscan river, over a distance of seventeen miles, to the city of Three Rivers. The present development is for 600 horse power delivered at the end of the transmission line, but the plant has been laid out with the view of increasing this largely for future demands. The most interesting feature in connection with this transmission plant is the novel method in which the new two-phase power is applied to an old electric lighting plant, which had previously been in operation, using single-phase alternating apparatus and a series arc system driven by steam power. The new

ing plant having capacity for delivering 1,000,000 gallons every twenty-four hours, which supplied the water service of the city. Both the lighting and the pumping plants were owned by the municipality of Three Rivers, and had been operated by them for over six years. A careful system of accounting has shown, however, that even with higher rates for service than are charged elsewhere by private companies, this municipal plant was running behind every year. The city authorities, therefore, decided to dispose of the plant and stop the continued outlay necessary to supply the yearly deficits in their lighting and pumping account. The plant was accordingly sold to the North Shore Power Company at

a very large reduction from its original cost, and a contract made with that company for supplying the street lighting and pumping service required by the city at rates which are usual in cities of this size and character.

The company, in order to lessen the cost of such service, decided to employ water power, which is quite plentiful in this portion of the province of Quebec. The most available powers were at considerable distances from the city, and the cost of transmission was at first thought to be too great, but a careful investigation went to show that by utilizing the Grande Chute of the Batiscan river the cost of the transmission line would be comparatively small, and that the necessary investment for the hydraulic and electrical plant would pay a very good return.

THE WATER POWER.

This beautiful water fall, a view of which is shown in cut No. 1, was almost ideal for a development of this character; the waters of the Batiscan at this point tumble over rocky ledges, giving a total fall of sixty feet within a distance of 100 yards. The Batiscan river

nearly all the dam work for its utilization had already been done by some volcanic upheaval, so that it only required the expenditure of a little over \$1,000 on masonry work to render the large natural force of this power available in a very convenient form.

A general view of the premises is shown in illustration No. 2. It will be seen that only a short length of stone masonry work was necessary to form the dam and head gate construction. The stone for this work was procured on the spot by blasting away portions of the ledge, and the dam was built directly on the granite rock which formed the crest of the fall. The artificial dam only extends half way across the stream, the other part being a natural spillway over which the waters fall, as shown in view No. 1.

From the head gates the water is conducted in a steel flume down through a natural gulley directly underneath the power house, a distance of 400 feet. The flume is 6' 6" in diameter, and is built up in 6' lengths of one-quarter inch boiler plate, supporting foundations being built underneath it every 15 feet. It is the intention to



NO. 2—GENERAL VIEW OF THE PROPERTY AND POWER HOUSE.

always has a large and regular flow of water in all seasons of the year, being fed by large lakes a long distance back in the Laurentian Mountains. The power of the whole fall is estimated at over 3,000 horse power, but only a portion of this is utilized for the present requirements of the plant. In addition to this large and constant flow of water, this fall has the particular advantage of being free from a bug-bear of all water power plants in cold climates—frazil. This is a peculiar ice formation differing both from anchor ice and slush ice, and which is much more dangerous to water wheels and racks than either, for it does not usually float on the surface of the water, especially if the current is swift. It forms only in open water, and in still water will rise to the top, so that the only reliable method of avoiding its dangers is to have a large still body of water above the dam. Immediately above the Grande Chute the water is dead and covered with ice in winter for a mile and a half up stream, so that there is no fear from this source.

This magnificent power seems to have been designed by nature for the purpose to which it is now being put;

cover the flume before cold weather sets in with spruce boughs, over which the snow covering will make a protective blanket against the intense cold of winter.

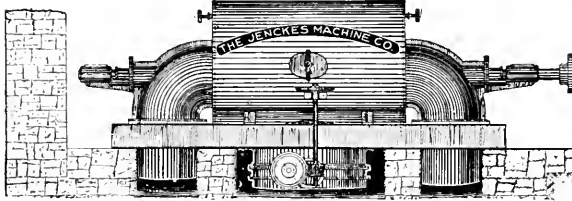
THE POWER HOUSE.

The power house, shown in cut No. 2, is a substantial stone structure, and has for its foundation a flat ledge of granite. It is 62' in length by 36' in width, and is designed in such a way as to allow an increase of the present equipment as the demand for power grows beyond the present wheel installation of 800 horse power.

The lower end of the steel flume is terminated by a large head sheet, which is provided with a gate valve for draining when the water is shut out; a few feet from the lower end, and directly beneath the wheel cases, the water for supplying the turbine is taken from the feeder or flume by means of two branch pipes, these branch pipes leading vertically upward and connecting with the wheel cases, and being supplied with shut-off gates to clear the turbines of water when required.

The wheel cases stand directly on the floor of the power house on iron girders supported by heavy stone

walls. They are built of 5/16" boiler plate 6' in diameter, with, heavy cast iron heads, terminating in heavy quarter turn elbows 30" in diameter, each of the elbows forming the discharge of one of the turbines, and at the same time providing a bearing for the shaft which runs entirely through the case. The wheels are 20" in diameter, two being mounted on each shaft, and are arranged so that they discharge in opposite directions, equalizing the thrust and giving an even and uniform power on



NO. 3- ONE OF THE WATER WHEELS, IN CASE.

the wheel shaft. Each unit of two 20" wheels gives over 400 horse power under a 50' head, running at 400 revolutions. The turbine shafts are connected directly to the generator shafts, thus doing away with the gearing and forming an ideal way of driving the generators.

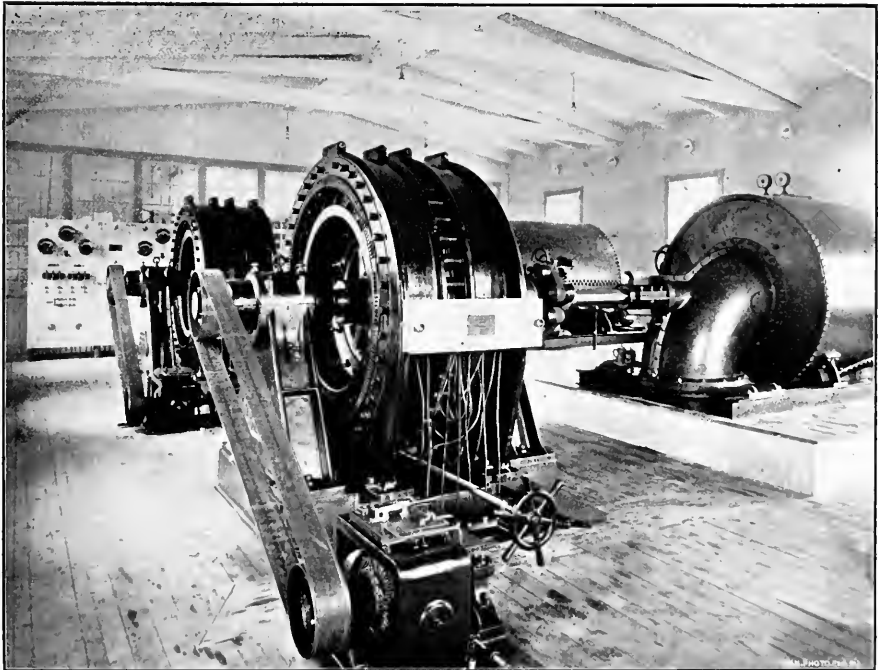
Cut No. 3 gives an illustration of one of the cases, with its arrangement, taken from a drawing prepared

are of the S. K. C. two-phase type, of 240 kilowatts capacity each, and were supplied, together with the rest of the electrical equipment, by the Royal Electric Company, of Montreal. The generators are connected directly to the turbine shaft by means of a flexible insulated coupling. These couplings are made of sole leather links, which connect projecting pins on the generator and turbine halves of the coupling. They have proved extremely satisfactory in service even when the shafts have not been in true alignment. The exciters, of which there is one for each machine, are belted to the other end of the generator shaft.

The current is generated at a pressure of 2,400 volts, and at a frequency of 16,000 alternations per minute. This periodicity was adopted because the electrical distributing apparatus at Three Rivers was designed for this number of alternations, and it was not considered advisable to change it. A neat switchboard of white marble has been installed to properly regulate the generators, which are designed to operate in parallel.

From the switchboard the current is carried to the step-up transformers, where the pressure is raised to 12,000 volts.

These transformers are placed in a separate room,



NO. 4- INTERIOR OF GENERATING PLANT.

for the plant, which will show more fully the compactness of this design. The wheels are of the Crocker type, and they, together with the flume and head gate work, were supplied and installed by the Jenckes Machine Company, of Sherbrooke, Quebec.

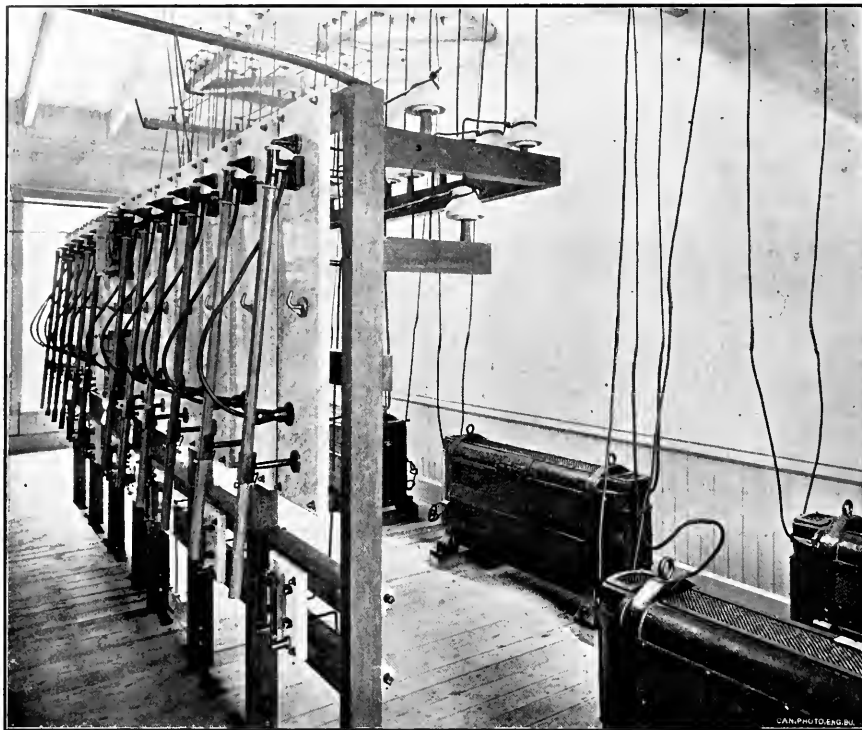
THE GENERATING PLANT.

The interior of the generator plant is shown in cut No. 4. The electric generators, of which there are two,

which is divided from the main room by a glass partition. A view of the step-up transformer room is shown in cut No. 5. The transformers are in 60 kilowatt units, or four for each phase of the plant; they are of the self-cooling type, using neither air-blast or water to keep the temperature down. The primary and secondary coils of each transformer are controlled by separate switches, so that they can be readily thrown in or out of service as required. The switches on the

12,000 volt side are of the S.K.C. non-arcing plug type, as can be seen from the illustration. These switches will break a 12,000 volt arc effectually, with no danger to the operator or the switch, and form a valuable adjunct to the plant. The 2,400 volt switches are of the

Considerable difficulty was experienced in procuring insulators suitable for this work. The requirement was that they should stand a high voltage stress of 40,000 volts for five minutes when placed in a salt water bath, and the hole for the pin also filled with salt



NO. 5—STEP-UP TRANSFORMER ROOM AND HIGH POTENTIAL SWITCHBOARD.

ordinary jack-knife type. On this step-up transformer board there are also placed two static ground detectors; they are for indicating any grounds on the transmission line, and are connected directly to the high pressure wires. From this board the wires are led to the cupola on the roof of the building by means of the porcelain line insulator construction shown in the illustration.

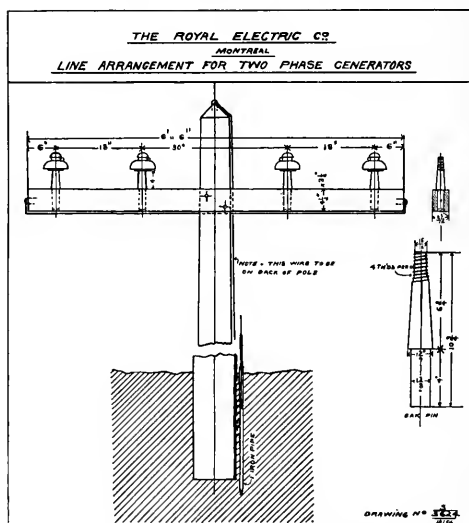
Taking it as a whole, this power house is a model of neatness and compactness for a plant of this kind. The interior is painted white throughout, and presents a clean and cheerful appearance.

From the power house the transmission line leads directly up the side of the mountain, and thence off on almost a straight line to Three Rivers. The country through which it passes is diversified between bush, public highway, farm division lines, and finally along the right of way of the Canadian Pacific Railway, which it follows for the last eight miles.

LINE CONSTRUCTION.

The line construction is shown in cut No. 6. The transmission circuit consists of four bare copper wires, No. 4 B. & S. gauge. This transmits the full power of the two generators over the 17 miles with a total loss of ten per cent., of which a little more than two per cent. is due to induction. The poles used are of white cedar 35' in length and 6" in diameter at the top, set 5' in the earth. The wires are placed 18" apart, and supported on special high voltage porcelain insulators.

water. Of the first lot supplied almost all failed in the test and were not accepted. Another manufacturer,



NO. 6—METHOD OF LINE CONSTRUCTION.

however, supplied insulators of which less than 2% failed under this test.

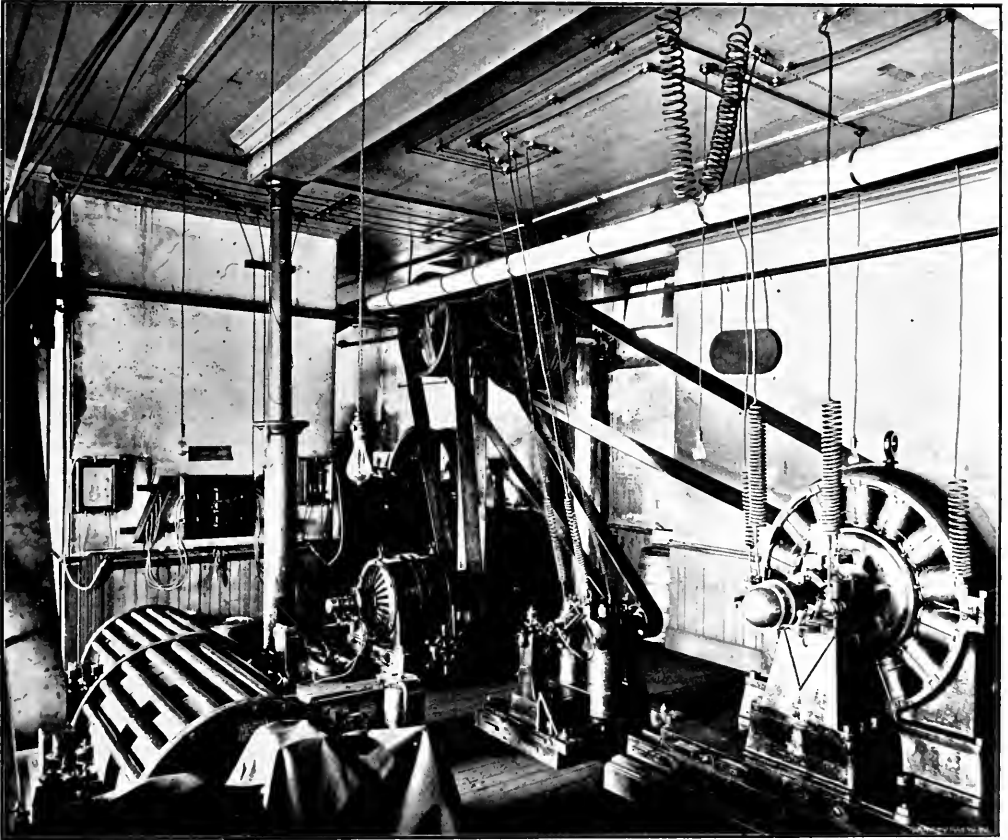
The pins supporting the insulators are made specially

tall to keep the wires free from wet snow, which falls heavily in this region.

This line construction is giving very satisfactory results, the only accident being on the first night of the operation, when a limb of a tree got across the wires, the result being that the limb and the wire were both burned off at that point. Since then there has been no trouble whatever.

On the top of the poles and at each end of the cross arms are fastened lines of ordinary barbed fence wire as a lightning protector. These wires are attached with ordinary staples and grounded at every sixth pole, by means of extending a galvanized iron wire down through an iron pipe planted beside the pole. This lightning protection is supplemented by banks of lightning

the side of the bridge is used. The wires run directly to the old power house at Three Rivers, which is used as a distributing station. Here step-down transformers are used to reduce the pressure to 1,100 volts, which is the voltage formerly employed in the old lighting service. A transformer board similar to the one in the power house at Grand Chute is used to cut in and out each individual transformer. The transformers used for incandescent lighting are made with regulating secondaries, so that the voltage on the lighting circuits can be controlled from here as well as at the generator. The old incandescent circuits were attached just as they were, no change of any character being necessary. The employment of 16,000 alterations in the new plant allows the use of the old transformers, while if a lower



NO. 7—ARRANGEMENT FOR SUPPLYING THE ARC LIGHTING SERVICE.

arresters at each end of the line. This method of lightning protection has proved itself thoroughly efficient during the past summer, in which time there occurred numerous electric storms without producing any trouble.

A telephone line, which is not shown in the cut, was afterwards strung by using ordinary galvanized iron wire attached to side brackets below the cross arms. Ericsen's anti-induction instruments are used and no annoying hum is experienced. The ordinary solenoid instruments, which were first installed, did not operate well when the line was heavily loaded.

The line crosses the St. Maurice river on the highway bridge just outside of the city of Three Rivers; here the ordinary cross-arm construction built out from

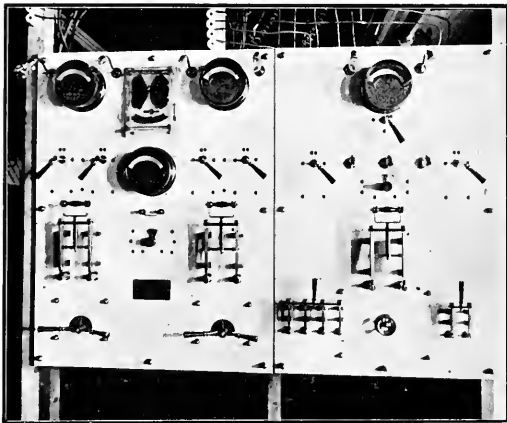
frequency had been employed, it would have been necessary to change them for new ones designed for the lower periodicity. The incandescent service is much improved since it has been operated in this manner instead of by means of the old steam plant.

THE ARC LIGHTING SYSTEM AND SYNCHRONOUS MOTOR.

Cut No. 7 shows the arrangement for supplying the arc lighting service. This was formerly supplied by two Royal arc dynamos, shown to the left of the illustration, belted direct to the engine pulleys. The new arrangement is to use the old 1,500 light single phase alternator as a synchronous motor operating from one phase of the two phase circuit to drive the arc machines instead of the engine, the other parts of the arc sys-

tem, switchboard, connections, circuits and lamps remaining the same. The dynamos were not even moved from their former position, so that in case of accident to the water power the old belts can be put on and the plant operated by the steam engines as before. All that was required to accomplish this change was to place a shaft overhead to which all machines are belted, and to install a 10 horse power induction motor to bring the old alternator into synchronism with the generators at the power house. Clutch pulleys are used for driving the arc machines, so that the starting motor has only to start the synchronous motor and the shaft. When the synchronous motor is brought to speed, the current is thrown on and it immediately takes the load and the starting motor is shut down; the arc dynamos are then thrown into service with the clutch pulleys and the arc lamps operated in an entirely satisfactory manner. This is another reason for employing 16,000 alternations, for, if a lower periodicity had been employed, the old alternator being a 16,000 alternations machine, could not have been used for this purpose.

It is found that 60 kilowatts delivered from one phase



NO. 8—SWITCHBOARD IN DISTRIBUTING STATION.

of the generator will supply all the loss in transmission, the losses in the motor, shafting and arc machines, and operate 78 1,200 candle power lamps, with their circuits, which are about four miles in length. The simplicity and economy of this method of operating an old plant is strongly in favor of the flexibility of the two phase system for transmission work.

SWITCHBOARD AT DISTRIBUTING STATION.

Cut No. 8 shows the switchboard used at the distributing station. It is composed of two panels of white marble, having the instruments mounted directly on the slab; the right hand panel is for the synchronous motor. The ampere meter at the top is provided with a short-circuiting switch, so that it can be cut out when the plant is in operation; it is only used for the purpose of properly adjusting the field of the synchronous motor, so that it takes the least amount of current; that is, it is neither over nor under excited, so as to produce leading or lagging currents. Below the ampere meter is a synchronizer of the ordinary three lamp type, and on either side are seen the handles of duplex fuse blocks, which are on the back of the board; they are provided with two fuses each, so that if one should blow, by throwing this handle the other is immediately

thrown into service. Below are shown the main switch, the field switch and exciter rheostat, and the four pole two phase starting motor switch. The left hand panel shows the incandescent distributing board; it is for two circuits, such being the old distribution. Each circuit is provided with an ampere meter, two fuse blocks, main switch and transformer regulator head. In addition, there is an "S.K.C." static ground detector and a voltmeter, each capable of being thrown on either circuit by means of a changing switch.

PUMPING PLANT.

The pumping, which is done in the same building, was formerly performed by a duplex steam pump. This plant is now being replaced by two triplex double acting power pumps, each driven by a two phase motor; one of these pumps will be sufficiently large for the ordinary service, but the second will be started in case of fire or extra calls upon the plant. The water will be pumped directly into the mains, no reservoir or gravity pressure being employed. In order to utilize the constant speed of the motors, the discharge pipes of the pumps will be provided with relief valves, so that whenever the pressure in the mains exceeds the prescribed limit, the extra water will run back to the suction pipes through the relief valve.

This simple arrangement will enable the company to perform all the lighting and pumping service of the city by means of the water power seventeen miles distant and to close down the steam plant entirely. The steam plant, however, will still be retained as an emergency plant in case any accident should interrupt the water power service.

The changes above described have been accomplished with no interruption of the old service, and have utilized all the electrical apparatus except the 750 light alternator, which is now not required. No money whatever has been required for changing the distributing system in order to accommodate it to the two phase current transmitted from the water power, and in accomplishing this the arc and incandescent services have both been very greatly improved.

ELECTRIC VS. STEAM RAILWAYS.

STEAM railways have now to reckon with the competition offered by electric roads for local passenger traffic in the vicinity of cities. The only way in which the steam roads can hope to retain a fair share of this traffic is by meeting the low rates offered by the electric roads. We are told that the Grand Trunk Railway Company lost a valuable passenger business between Hamilton and Burlington, by refusing to meet the wishes of the people in the matter of a reduction of rates. In consequence of this refusal, the people who had been accustomed to travel on the steam road transferred themselves to the Burlington Electric Railway Company's cars. When the Grand Trunk people saw their traffic slipping away from them, they announced a reduction in rates to the figure which they had previously refused to grant. Their offer came too late, however. They had antagonized their customers, who, having found the electric road cheaper and more convenient, refused to come back. As a result the G.T.R. trains are running light and the electric road is doing a rattling trade.

The Jenckes Machine Co., of Sherbrooke, shipped last week a complete tramway plant to the Lucky Jim Mines, at Sandon, B.C.

THE STEAM ENGINE INDICATOR.*

By G. B. RISTER.

The indicator is an indispensable assistant to the engineer, and of late years it has become evident that intelligent and wide-awake steam plant owners recognize the necessity for such a valuable instrument, and they are also appreciating the services of the engineer who is competent to use it properly.

The indicator diagram is actually the only means of showing on paper what really takes place in a cylinder. To read an indicator card correctly is not an easy matter, and in order to be able to do so, considerable study and practice are necessary. The handling of such a delicate instrument requires a great deal of care, and sometimes considerable skill and ingenuity must be employed in making the needed attachments. By its use many stumbling-blocks will be removed, while the calculations and geometrical work which the engineer will be impelled to make in connection with it will lead to the acquisition of a good, general knowledge of the whole subject. Careful consideration of the diagrams from different engines, under varied conditions, cannot fail to lead to thought and investigation. A general knowledge of the law of gases (especially Mariotte's law) is needed, and a study of physics, mensuration and mechanics is most beneficial.

In order to determine the most economical plan of operating a steam plant, many tests are made. Such tests if properly conducted are valuable, and are much to be appreciated by steam plant owners, who will find it to their interest to give every encouragement and assistance to the engineer along this line. The diagrams traced by the indicator pencil will vary widely, and depend on the condition of the different engines from which they are taken, and it therefore becomes necessary to know how to interpret these variations correctly. This information the engineer can only acquire through the processes of reasoning and hard study. In attaching the indicator considerable skill is sometimes needed, and circumstances must determine what plan can best be employed. The reducing motion must be such that it will give to the paper barrel in its reduced scale an exact reproduction of the movement of the piston.

Examine your indicator and see that every part of it is moving freely, has no lost motion, and is well oiled. A cord that will stretch is to be avoided. Good judgment is required in putting the proper tension on the paper barrel spring for differently speeded engines. The indicator springs should be tested occasionally to see if they agree with a standard steam gauge of known accuracy. Do not use too tight a spring for the pressure. If the instrument is a reliable one, and the necessary precautions have been taken in every particular, the diagram will then show you the pressure acting on the piston on both sides, and at any part of the stroke during one revolution of the engine, and that is all it will do. Knowing the scale of the spring, it is an easy matter to determine the pressure at any point of the stroke. This little tell-tale instrument will leave on a piece of paper a good deal of information, providing the atmospheric pressure line is properly established on the diagram. It is of the greatest importance that this line be drawn correctly, as it is the neutral line of the diagram, and from it all pressures above and below must be determined. After removing the card from the paper barrel it is advisable that all data be made on it as complete as possible, and then will its study be pleasant and profitable.

The following terms are used in speaking of the different lines and curves: The atmospheric line, vacuum line, admission line, steam line, exhaust line, counter pressure line, compression and expansion curve. The beginning and termination of some of these lines are called points, and their continuation indicates periods in the stroke of the piston. Technical terms for pressure are as follows: Boiler pressure, absolute pressure, initial pressure, cut-off pressure, terminal pressure, back pressure, and mean effective pressure. The mean effective pressure is what we must find in order to calculate the indicated horse power of the engine, and the indicator card is the only means of getting it correctly.

Having once established the mean effective pressure from the diagram, the work done in one stroke, in foot pounds, can be calculated as follows: Multiply 144 by the mean effective pressure, and by the cylinder volume in cubic feet, displaced by the piston. Two simple and easily remembered rules for finding the indicated horse power when the mean effective pressure is known, are as follows: 1. Multiply the mean effective pressure by the cylinder area in square inches and by the piston speed in feet per minute, and divide by 33,000. 2. Multiply the mean effective pressure by the length of the stroke in feet, by the area of the cylinder in square inches, and the number of strokes per minute, and this, divided by 33,000, will equal the indicated horse power. From the foregoing it can easily be seen that the indicator is invaluable in determining the work done by an engine.

But this is not all, by any means. An analysis of the expansion curve, which requires considerable knowledge and accurate working from a geometrical and arithmetical standpoint, is of great value, and the

nearer the actual expansion curve of the diagram approaches the theoretical (often called the equilateral hyperbola) the greater will be the economy. A considerable deviation from the actual and the hyperbolic curve impels the engineer to think and to reason out the cause. A leaky piston, a leaky steam valve, re-evaporation in a cylinder, or a leaky exhaust valve—all these tend to bring about an expansion curve, which is not in accordance with the law of gases laid down by Mariotte, viz., that the volume should vary inversely as the pressure. This, of course, is to some extent an impossibility in an engine cylinder, owing to loss of heat and leakage. Nevertheless, diagrams have been taken from steam engines which are a credit to the engineer, as well as to the engine builder, and are almost identical in the expansion curve to the hyperbola. It is not advisable to come to hasty conclusions in regard to the expansion and compression curve, as well as other lines, because the laws of nature can have quite an influence in this respect, owing to the surroundings and conditions under which a steam engine may be working. The engineer well knows that dry steam should be furnished to an engine; therefore, it is reasonable to state that the steam boiler at times can be held responsible for a diagram which does not approach the ideal. If the steam pipe leading to the boiler is too small in diameter, the indicator diagram will give an indication of it, but this should be verified with the diagrams taken direct from the steam chest or the steam pipe. The indicator card will furnish the means of knowing how the steam is distributed in the cylinder. If the valve gear is not properly working the card will show it. With calculations from the diagram we can find with what sort of economy, mechanically and thermodynamically, the engine is working, and if underloaded or overloaded the engineer will be in a position to advise his employer exactly what changes should be made in order to insure greater economy in fuel. The steam line may show considerable initial expansion or loss of boiler pressure, and the back pressure line can point out excessive resistance to the piston. Both cases are evidence of wasteful expenditure of steam.

Economy, to the engineer, means keeping down the fuel account, having small bills for repairs, little or no loss from shut-downs, regular speed, and the least possible loss from deterioration. The engineer must be guided by circumstances, and if he finds himself confronted with conditions that render the attaining of strict economy impossible, he then can only make the best of bad surroundings. Steam engine economy is made up of many factors, and it is to be hoped that the endless study and exertion on the part of the intelligent and ambitious engineer will be appreciated by the employer.

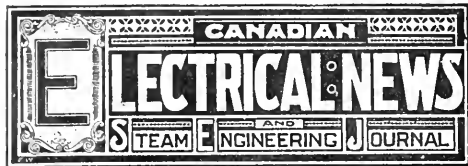
It is my belief that many steam plant owners or managers are willing to assist the engineer financially in obtaining such an instrument as the indicator, as well as other most valuable appliances, which would serve as aids in many instances to the greatest economy.

My employers, The Advertiser Printing and Publishing Company, of London, have recognized the wisdom of this, and assisted me to the extent of \$50 in purchasing an indicator in 1893, and also obtaining for me in 1896 a free engineer's scholarship with the International Correspondence Schools, in Scranton, Pa.

RECENT CANADIAN PATENTS.

PATENTS have recently been granted in Canada for the following electrical and steam engineering devices: No. 56,453, electric railway, Harry C. Reagen, jr., Philadelphia, Pa.; No. 56,457, steam boiler, Edward J. Cusack, Havelock, N. B.; No. 56,464, steam engine, Johan Burchardt Opsahl, Toronto; No. 56,501, electric furnace, John Joyce, Andover, and James A. Denther, Boston, Mass.; No. 56,504, ore reducing electrical machine, Charles P. Tatro, Seattle, Wash.; No. 56,578, application of telephone to electric bell systems, Frederick Hodgson, Hampstead, and George A. Edwards, Peckham, Surrey, England; No. 56,580, governor for waterwheels, Marcus P. Schenk, Springfield, Mass.; No. 56,632, governor for steam engines, E. B. Thornburn, Hightstown, New Jersey; No. 56,649, rotary engine, David Morgan, Luncheon, Tasmania; No. 56,653, feed-water heater and condenser, James M. Keller, Denver, Col.; No. 56,660, electrode for storage or secondary batteries, Paul Ferdinand Ribbe, Lessingstrasse, Prussia, Germany; No. 56,662, storage battery, Albrecht Heil, Frankisch, Crumbach, Germany; No. 56,683, steam boiler, Edward Makin, Manchester, Eng.; No. 56,684, steam generator, Edward Makin, Manchester, Eng.; No. 56,759, dynamo electric machine, Wm. M. Morday, Loughborough, Eng.; No. 56,760, safety device for electric circuits, Lewis G. Rowland, Camden, N.J.; No. 56,761, telegraph or telephone cable and their connections, James M. Barr and C. E. S. Phillips, Castle House, Kent, Eng.; No. 56,782, switchboard annunciator, Bell Telephone Company, Montreal; No. 56,794, steam generator, David M. Thompson, Providence, R.I.; No. 56,798, steam indicator, Karl Mastard and Wilhelm Beerensson, Berlin, Prussia, Germany; No. 56,806, rotary engine, Elber B. Tree, Woodstock, and Robert H. Eldon, Toronto; No. 56,808, telephone toll apparatus, Siegfried Silberberg, New York, N.Y.; No. 56,809, toll apparatus for meters, Siegfried Silberberg, New York, N.Y.

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Use of the Incandescent Lamp.

WE have been watching with interest the growing use of incandescent lamps for decorative and advertising purposes.

During the recent jubilee celebration in Toronto some of the principal business and public buildings were handsomely decorated with incandescent lamps arranged in a variety of forms and in rich and harmonious colors. During the evenings when these illuminations were on view the streets were thronged with people till midnight. By the use of the incandescent electric lamp the windows of many large stores have been rendered even more attractive at night than in the day time. Electrically illuminated street signs are a conspicuous feature of the streets of New York at night, while an immense globe of blazing incandescent lamps surmounts the dome of one of the largest buildings on Broadway, and is a conspicuous object for miles around. There is large room for development in Canada in the use of electricity for such purposes as those mentioned, and wide-awake electric light managers and business men will find it to their profit to cultivate this field.

Municipalities and Street Railways.

WHEN public franchises are to be disposed of it is reasonable to expect that municipal authorities will endeavor to make the best bargain possible, and to receive the greatest remuneration for the privilege granted. It is just possible, however, that the conditions exacted in some cases may be of such a nature as to operate against the interests both of the municipality and the company securing the franchise. As an instance of this we may point to the street railway in the city of Hamilton. There, according to agreement, the street railway company has been compelled to pay to the city six per cent. of the gross earnings, besides a certain mileage charge. The company found themselves unable to do this, and a few months ago the city council passed an amended relief by-law, but it is said to have been so

loaded down with conditions that the company refused to accept it. The possession of a street railway franchise in the city of Hamilton is not likely to prove very remunerative to any company, and more especially under unfavorable conditions. It would seem to have been in the interest of the city to have given such concessions as would permit the company to pay a reasonable dividend to its shareholders, and improve the efficiency of its system. Being crowded financially, this became an impossibility. There is said to be a movement in favor of the city taking over the railway. Should this be decided upon the operation of the road will be watched with much interest.

Electric or Hydraulic Elevators.

THE new municipal buildings at Toronto are about to be equipped with elevators, for which tenders have been invited, and the question has arisen as to the comparative cost of operating and maintaining hydraulic and electric power machines. The first cost is greatly in favor of the electric elevator, while the architect has also recommended its adoption. The chief argument in favor of the hydraulic system is that when the heating plant in the building is in operation, the extra cost of fuel consumed to generate high pressure steam to supply power to operate the pumping plant is very small. It is further claimed that the exhaust steam from the pumping plant can be used to heat the building, thus lessening the cost of heating. Notwithstanding this, figures obtained by the architect of the comparative cost of operating the two classes of elevators in the principal buildings in Toronto show the average cost per day of electric elevators to be 58 cents, against 96½ cents for hydraulic elevators. From this it would appear that under ordinary conditions electric power for elevator purposes is the more economical, but in many cases the choice of elevator will no doubt be determined by special conditions and surroundings.

Prospects For Foreign Business.

It is most gratifying to observe that Canadian machinery manufacturers are securing a foot-hold in foreign countries, and that our goods are regarded as equal to those of any other manufacture. In electrical and steam engineering apparatus the outlook is fully as favorable as in other lines. On another page reference is made to a franchise secured by Mr. Chapman, of Montreal, for an electric railway in Jamaica, much of the machinery for which will, it is said, be supplied by Canadian manufacturers. It will be remembered that Mr. William Rutherford, formerly chief engineer of the Canadian General Electric Company, left last spring to accept the management of the electric traction department of the English engineering firm of Dick, Kerr & Company. Mr. Rutherford has recently been on a visit to America, and while here placed a contract with the Robb Engineering Company, of Amherst, Nova Scotia, for several high speed engines for electric tramway service at Barcelona and Madrid, Spain. He also placed contracts with the General Electric Company, of New York, and the Allis Company, of Milwaukee, for electrical machinery and engines to the value of one hundred and sixty thousand pounds. It is said that the prospects for European trade in electrical machinery are favorable, and the above facts would seem to verify the statement. Canadian manufacturers are certain to receive their share of the trade.

Electrical Cooking and Heating.

A COMPARATIVELY new field for the employment of electricity is its application for heating and cooking purposes. For the former purpose it has already been used in Canada to some extent, but electrical cooking is of more recent origin. Two Canadian manufacturing companies have lately placed on the market lines of apparatus for cooking and heating by means of the electric current, an exhibit of which was made last month at the inauguration of the Lachine Rapids Hydraulic and Land Company's plant at Montreal. In a paper read by Mr. J. P. Jackson before the American Institute of Electrical Engineers, some figures are given of the relative cost of cooking by means of electricity and coal as the source of energy, the results being determined by actual experiments. The cost of cooking three meals by the electric current was found to be 13.1 cents per meal, and the cost by coal 3.15 cents per meal. The energy required for four hours' ironing was produced by electricity at a cost of 22.7 cents, and by coal at 12.25 cents. The results of these tests would seem to indicate that for the ordinary cooking of a family electricity is yet too expensive to become very generally adopted, but there are many advantages in its use, such as cleanliness, decreased fire risk, convenience, etc., which will undoubtedly cause it to be employed by those who value these considerations above the single item of cost. It is also possible that with the more general adoption of electricity it may be in the interest of central stations to reduce the price charged, especially for day load service. There appears to be a growing recognition by central station managers that every possible means should be employed of increasing the day load, and electrical heating and cooking will provide a means of doing this.

CANADIAN ELECTRICAL ASSOCIATION.

THE Executive of the above Association, encouraged by the success of the convention at Niagara Falls in June last, are taking time by the forelock as regards the preparations for the convention to be held in Montreal next year.

At a meeting of the Executive Committee held recently, Messrs. C. B. Hunt, A. M. Bowman, A. A. Dion, J. J. Wright, A. M. Wickens, W. H. Browne and the Secretary were appointed a committee to procure suitable papers.

The following persons were appointed a committee to endeavor to extend the membership of the Association: Messrs. F. C. Armstrong, J. A. Kammerer, K. J. Dunston, A. A. Dion, O. Higman, F. H. Badger, E. E. Carey, and the Secretary.

A committee on arrangements was appointed as follows: Messrs. Wm. Thompson, W. H. Browne, John Carroll, L. B. McFarlane, J. A. Baylis, F. H. Badger and O. Higman.

It is gratifying to see this evidence of the determination of the Executive to complete as early as possible arrangements which will tend to ensure the success of the Montreal meeting.

The Association is actively engaged in other directions also in behalf of the electrical interests, and is receiving the hearty co-operation of many of the electrical companies. Those companies which have as yet failed to reply to the circular recently issued by the Association, should do so without further delay, and fall into line with those who have already promised co-operation with the work which the Association has in hand.



LACHINE RAPIDS HYDRAULIC & LAND COMPANY—A WINTER VIEW OF THE UNCOMPLETED POWER HOUSE.

INAUGURATION OF THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY'S POWER PLANT.

THE inauguration of this company's new hydraulic and electric plant at Montreal took place on Saturday, September 25th, under favorable weather conditions. The directors issued nearly three thousand invitations to prominent persons in Montreal and elsewhere, and the company's magnificent power house, nearly one thousand feet long, was crowded with visitors. Letters of regret were read from Sir Wilfred Laurier, Hon. Messrs. Marchand and Robidoux, Sir Adolphe Chapleau, Hon. W. S. Fielding, Hon. A. G. Blair and others.

Those who, previous to the construction of these works, had been acquainted with the general appearance of the Lachine rapids at point of utilization, were pleased to observe that the carrying out of such an immense industrial enterprise had not in any way marred the beauty of the rapids. The neat appearance of the power house, both externally and internally, was freely commented upon.

Promptly at 2 p. m. the president of the company, Mr. G. B. Burland, received the guests in No. 1 power house, and read an interesting address, which in part will be found below.

PRESIDENT'S ADDRESS.

A little over twelve months ago, said Mr. Burland, I stood almost upon this same spot, and made certain statements and promises to those present; to-day, in the name of the directors of the Lachine Rapids Hydraulic and Land Company, I invite you to witness how these statements have been fulfilled and the promises carried out. I told you that we would divert the river from its course, and excavate its bed; that we would build a wing dam a mile long and a cross dam 1000 feet long; that we would then restore the river to its place; that instead of a roaring torrent we would show you a still basin in which would be locked up a force equal to 8,000 horse power. I ask you now to look around and see whether we have accomplished all this. We have accomplished more; we have here a power which registers not only 8,000, but 21,000 horse power.

I will not detain you with any details of construction. You see results, which speak more strongly to you than any mere statement of mine: The 300,000 yards of rock removed; the millions of feet of lumber in our dam; the thousands of yards of cut stone and concrete; the tons of steel, and the thousands of men employed, and all this has been accomplished without a single loss of life or serious accident of any kind; without any outside financial assistance; without any excess of expenditure over estimates; without any payments for extras, and without any mistakes either in calculations or construction.

I will not detain you longer to discuss such myths as back water, frazil and ice pressure. The best proof that we believe they are myths is that fourteen (14) of our subscribers were found willing to invest \$1,400,000 of their own hard-earned cash in the enterprise. Our temporary works have been here over a year, and we experienced no trouble from ice pressure; we saw nothing of back water, and we did not find enough frazil to stop up the leaks in our temporary dams.

Our capital in the first instance was \$1,000,000. That amount our engineers deemed sufficient to acquire rights, to construct head and tail races, power house, and install 66 water wheels,

with the necessary gearing and jack shaft. How far they have succeeded in their estimate you may gather from the fact that since the commencement we have increased the number of wheels from 66 to 72. We have deepened 1,200 feet of the river bed below the main dam, removing an immense reef of rock, which was the great stumbling block to all who went before us. We have constructed a system of booms and guard piers in our head race. We have extended the length of our power house over 120 feet, and notwithstanding this, when all our work is completed as you see it to-day, we are still \$25,000 under our original estimates, a fact in itself which crowns the ability of our engineers.

The engineers' estimate of the power produced under the first contract was about 8,000 horse power. To-day they have provided for installing 72 wheels, each of which is capable of giving, under a thirteen foot head, 300 horse power, or a total of twenty-one thousand six hundred (21,600) horse power, and the head on our wheels is to-day (if any one of you here present have a doubting spirit and a tape measure or rule, you may satisfy your own curiosity) between fifteen and sixteen feet, which will yield much more power than that already given.

Now, it stands to reason that if it was estimated to cost \$1,000,000 to complete the hydraulic installation and to supply power on the jack shaft, the same power could not be converted into electricity without an increase of capital. It was for this purpose that the capital of the company was increased from \$1,000,000 to \$2,000,000. We have in reserve, therefore, for our electrical transmission and distribution over \$900,000, which, in our opinion, will be ample to provide a transmission and distribution system to market the whole of our power. Already we have constructed an underground system in Montreal, which, in itself, we look upon as a step in advance and in the right direction, that will, we hope, rid our streets of the unsightly poles, and rid our firemen of the difficulty of fighting fires through a network of wires. Eighty miles of underground conduit have already been laid, including cables crossing the canal, and a sub-station has been erected, situated on the corner of McCord and Seminary streets, in the city of Montreal.

Our transmission line, starting from this power house to the Curran bridge on Wellington street, has been constructed in the most permanent manner, of latticed iron poles embedded in concrete, sufficient to stand any strain on the wires during the heavy winds and sleet storms of winter.

Cooking by electricity is also making progress. The ladies will be interested in seeing the tea and coffee made by the current from the rapids to-day. Already broilers, chafing dishes, coffee pots, five o'clock tea kettles, hot water urns, smoothing irons and curling tongs can be obtained from any electrical supply dealer, and it will be the aim and object of this company to supply current at a rate which will allow of their more extended use. We will very soon be prepared to install a separate meter to measure the current used in cooking, and furnish the same at a still greater reduction.

The accomplishment of this great project and the economy of its construction is ample evidence of the skill and ingenuity of our engineers, and the capability of our contractors, Messrs. Davis & Sons, with others engaged in the work, who have in no small degree assisted in the satisfactory and wonderful result you now see before you.

At the invitation of President Burland, R. Wilson Smith, Esq., mayor of Montreal, turned the water on six of the wheels and started the machinery in motion. Mrs. Burland closed the switch, completing the circuit between the Lachine Rapids and the City of Montreal.

The building is an immense structure, nearly 1,000 feet long by 50 feet wide, running directly across the river. The superstructure rests upon huge cut stone

piers, resting upon the bed rock of the St. Lawrence, and laid in Portland cement. At the shore end of the superstructure is a square brick tower, used as offices for the staff, and equally distant are three square brick buildings with slate floors, which will contain the generators and switch-boards. The wheels are so arranged that they are in parallel rows the entire length of the building.

The head race or dam is 4,000 feet long by 1,000 feet wide, with an average depth of 13 feet, making a beautiful stretch of perfectly smooth water running parallel with the shore.

THE HYDRAULIC MACHINERY.

The hydraulic installation, when complete, will consist of seventy-two 57 inch Victor wheels with cylindrical gates, connected up in twelve series of six each by means of mortise bevelled gearing and horizontal shafting directly connected to the generators.

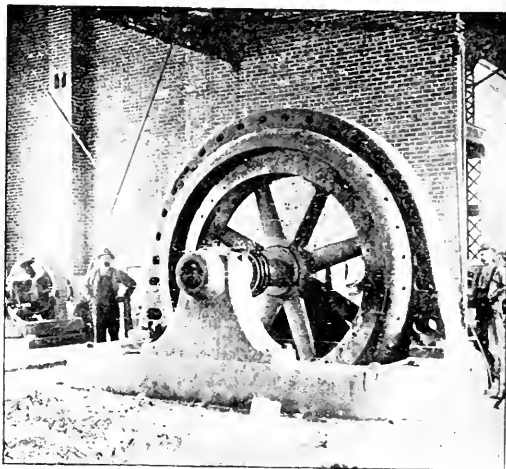
The wheels are governed by an improved governor, known as the Gesler, which is supposed to operate instantaneously the gates of the wheels. The flumes, 36 in number, in which the wheels are placed, are 20 feet wide by 40 feet long, and contain two wheels in each. Forty-eight of the wheels are already installed and twenty-four of them connected to generators. Each wheel is capable of giving 300 horse power under a 13 foot head, so that when installation is complete the hydraulic machinery will be capable of generating 21,000 horse power.

THE ELECTRICAL MACHINERY.

The electrical installation, when complete, will consist of twelve 750 k. w. three phase generators, made by the Canadian General Electric Company, each direct connected to six water wheels and operating at 4,400 volts at 175 revolutions. The generators are of the revolving field type, and each have separate belt driven exciters. Four of these generators are already installed

with common buss bars, the centre panel being devoted to the exciters and containing ammeter, volt meter, switches, rheostats and pilot lamps, while on the other side are the panels of the main generators or alternators, which contain high tension, quick breaking switchers, high pressure volt meters, ammeters and synchronizing lamps.

A magnificent repast was provided by the directors. At 5 o'clock the guests again assembled in power house No 1 to listen to congratulatory addresses by



ONE OF THE 750 K.W. C.G.E. 4,400 VOLT DYNAMOS.

His Worship, Mayor Wilson Smith, Hon. Thomas Duffy, Hon. J. I. Tarte, Ald. Prefontaine, M.P., Sir Jas. Grant, Hon. L. Beaubien, Hon. J. D. Rolland, John Crawford, Esq., and John Morrison, Esq., all of whom spoke in terms of highest praise, congratulating the engineers, Messrs. Walbank and Pringle, upon the successful achievement of their plans.

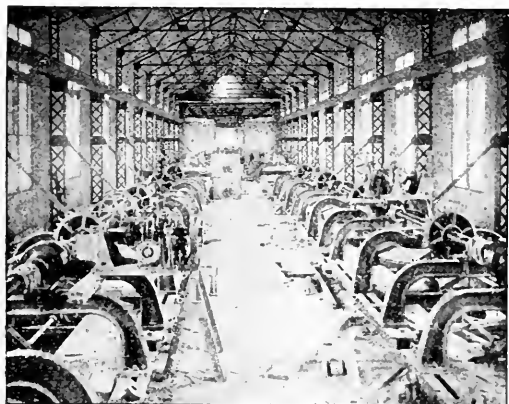
ELECTRICAL COOKING AND HEATING APPARATUS.

One of the most interesting features of the proceedings was the display of electrical cooking and heating apparatus. The Canadian General Electric Company's exhibit included three-phase induction motors, varying from thirty horse power to five, and a complete electrical kitchen, with range, pots, hot water urns, radiators, ventilators, chafing dishes, etc.; in fact, it fairly represented the utility of the electric current in the factory, the parlor, the kitchen, the dressing room, and even the invalid's boudoir.

The Dominion Electric Heating and Supply Company, of Ottawa, exhibited an excellent selection of heating and cooking apparatus, all made under Canadian patents and constructed in Ottawa.

The W. A. Johnston Company, of Toronto, showed Wagner transformers, long burning arc lamps, a single phase self-starting motor, and induction ceiling fan.

Mr. Kingsbury, an electrical engineer of Sydney, Australia, was a visitor to Canada during the past month, studying the developments in electrical science. Mr. Kingsbury was delighted with the evidences of Canada's progress in electrical engineering, a matter in which Australia is as yet comparatively young. He was impressed with the utility and general character of the Canadian street railway systems, and considers that a large business might be secured in Australia by Canadian manufacturers of electrical apparatus.



LOOKING DOWN THE POWER HOUSE FROM THE CENTRE.

and in operation, and four more are in course of erection.

Both the hydraulic and electrical machinery are evidently substantial and constructed with the greatest care, and so arranged that cost of attendance during operation will be reduced to a minimum.

THE SWITCHBOARD.

The switchboard is situated in the down stream end of the dynamo house, and at present has four panels,

THE LATE MR. F. B. ROBB.

The particulars of the sad death of Mr. F. B. Robb, of Amherst, N. S., are already known to readers of this journal. Deceased was secretary-treasurer and manager of the Robb Engineering Co., Limited, and was drowned while bathing at Fox Harbor, N. S., on July 20th. He was born at Amherst, Nova Scotia, on the 8th of November, 1857. His father, the late Alexander Robb, was one of the pioneer manufacturers of Nova Scotia, having established in 1848 the business which has since developed into the Robb Engineering Company.

The subject of our sketch received his education at Cumberland County Academy and Dalhousie College, Halifax, afterwards being especially fitted for his work by a short experience in banking and commercial college course at St. John. In 1876, when only 19 years of age, he, with his brother, D. W. Robb, now president and engineer of the company, took the full management of the extensive business in which he labored up to the time of his death.

Mr. Robb's strongest characteristic was unceasing industry both of body and mind. Having a love of work, and being gifted with quick perception and methodical habits, he was able rapidly to master every detail of his work, and has been largely instrumental in building up the Robb Engineering Company's busi-



THE LATE MR. F. B. ROBB.

ness, which has during the past few years extended to all parts of Canada.

The late Mr. Robb had a very sympathetic nature, and early in life was impressed by deep religious feeling, which prompted him to take a prominent part in the work of every religious and charitable organization that came in his way. There are probably few men who have done more personal work in the way of assisting others, especially boys and young men, and by acts of kindness and good counsel leading them to a higher plane of living both morally and physically. Mr. Robb was an elder and active member of the Presbyterian church of his native town. He was especially interested in the Y. M. C. A. work among boys and railway men, being chairman of the Y. M. C. A. Railway Branch. At the time of his death he was assisting in the management of the Y. M. C. A. Boy's Camp, which every year gathers the boys for an outing at some one of the lovely spots on the sea coast of Nova Scotia or New Brunswick. Through his intense desire to do good he was able to wield a large influence, not only in his own town, but in many districts all over the maritime provinces.

In 1883 Mr. Robb married Miss Jessie MacFarlane, neice of Senator MacFarlane, of Wallace, who, being also devoted to the work of religious organization, has been a congenial companion and helper in this department of his labor. She with her three children have the sympathy of many who mourn the loss of one who was ever a true friend.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

KINGSTON NO. 10.

Kingston association is apparently progressive. At a meeting on September 16th, a large number were present. In the absence of President Simmons, the chair was occupied by Vice-President Asseltine. The regular business being concluded, an interesting discussion took place on the merits of Taylor's hydraulic air compressor. The question-box contained a number of difficult problems, which were worked out on the blackboard. It was reported that a change had been made by the Executive in the members of the Legislative Committee, which is now composed of one member from each association at Toronto, Montreal, Ottawa and Kingston.

LONDON NO. 5.

An open meeting of the above association was held early in September, the chair being occupied by Mr. J. D. Campbell. Mr. G. B. Risler, past-president of the association, made a few remarks, stating that the object of their meetings was to mutually assist and instruct each other in the acquirement of greater knowledge by the interchange of members' ideas in engineering matters. The engineer could well be proud of his calling, and his true aims should be safety, reliability, intelligence and economy. It was the engineer who could, by skilfully managing his steam plant, bring about a good dividend for his employer. Addresses were delivered by Mr. Robert Angus, superintendent of E. Leonard & Sons, and Mr. Thos. McHattie, locomotive foreman of the G. T. R.

BERLIN NO. 9.

DEAR SIR,—The following is a correct list of the officers of the C. A. S. E., No. 9, Berlin: Past-president, W. Oelschlager; president, Geo. Steinmetz; vice-president, J. Heyd; secretary, W. J. Rhodes; treasurer, Wm. Tiedt; conductor, J. L. Bowman; door-keeper, Augt. Prizgodda; trustees, Oelschlager, Amdt, Sararas; auditors, Steinmetz and Oelschlager. The association meets every Friday evening.

Yours fraternally,

W. J. RHODES, Secretary.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 10.30	A.M. 5.30	7.00
2....	" 11.30	" 5.30	6.00
3....	"	" 5.30	4.40
4....	A.M. 12.50	"	
5....	" 1.50	" 5.30	3.40
6....	" 2.50	" 5.30	2.40
7....	No Light.	No Light.	.....
8....	No Light.	No Light.	.....
9....	No Light.	No Light.	.....
10....	No Light.	No Light.	.....
11....	P.M. 5.20	P.M. 7.40	2.20
12....	" 5.20	" 7.40	2.20
13....	" 5.20	" 8.40	3.20
14....	" 5.20	" 9.30	4.30
15....	" 5.20	" 10.50	5.30
16....	" 5.10	" 11.50	6.40
17....	" 5.10	A.M. 12.50	7.40
18....	" 5.10	" 2.00	8.50
19....	" 5.10	" 3.20	10.10
20....	" 5.10	" 4.30	11.20
21....	" 5.10	" 5.40	12.30
22....	" 5.10	" 6.00	12.50
23....	" 5.10	" 6.00	12.50
24....	" 5.10	" 6.00	12.50
25....	" 5.00	" 6.00	13.00
26....	" 5.00	" 6.00	13.00
27....	" 5.30	" 6.10	13.40
28....	" 5.30	" 6.10	13.40
29....	" 5.30	" 6.10	12.40
30....	" 5.30	" 6.10	12.40
.....

Total, 214.20

QUESTIONS AND ANSWERS.

WE have received the following answers to the engineering questions asked in our September issue:

ANSWERS BY MR. A. M. WICKES.

"ONTARIO": (1.) Should use oil carefully. Put up a tin or metal splashers to keep oil off the belt. (2.) In raising the speed you increase the horse power; and in lowering the speed the horse power is decreased—the boiler pressure remaining the same. (3.) It is most economical to carry the pressure of such a height that the point of cut-off is between $\frac{1}{4}$ and $\frac{3}{8}$ of the stroke; the release should be very near the atmospheric pressure. There is not sufficient data for the latter part of the question to be answered intelligently. What kind of pumps? What is the system of the drying room, live steam or exhaust? If exhaust, what is the back pressure?

"SUBSCRIBER": If subscriber's engine is $9\frac{1}{2}$ " diameter \times 12" stroke, the piston speed at 280 revolutions per minute is 560 feet per minute. 80 pounds of steam cut off at $\frac{1}{4}$ stroke is equal to a ratio of 4. This would give an M. E. P. of 41.68 lbs. per square inch. The piston, being $9\frac{1}{2}$ " in diameter, has an area of $9\frac{1}{2} \times 9\frac{1}{2} \times .7854 = 70.88$.

$$\frac{70.88 \times 560 \times 41.68}{33,000} = 50 \text{ h. p.}$$

250 amperes at 115 volts = 28,750 watts.

$$\frac{28,750}{716} = 40 \text{ h. p.}$$

"J. G.": Can use an exhaust steam for heating his building by piping it correctly and having sufficient radiating surface. If his coils or radiators have surface enough to heat the building at, say, 2 lbs. pressure, he can get a perfect circulation by adopting the principle of giving the steam ample room to travel, and giving plenty of fall in the direction of travel; first, run a main riser of ample size near the centre of the building, and up to the coils of the top flat. This main should have no outlet except those going to coils or rods. Tap the riser for the coils each way several feet above the coil, and set coil with good fall. At each end of building put up relief pipe riser, with safety valve on top; set to blow off at 2 lbs. Discharge all coils into these. At the bottom of each riser a relief or drain pipe should be put in and be piped to tank or hot well or drain.

"JAS. JOHNSTON": You should put in good bridge walls back of gates, a damper at the stack mouth, and fire carefully—regulating by stack damper.

"JAS. McPHERSON": One of the boys thinks that if you have run that elevator without oil for four years, it would be a waste of money to use any now.

ANSWERS BY MR. WM. THOMPSON.

"J. G.": You can hardly expect to heat your building by exhaust steam without some back pressure, no matter how slight. You must also bear in mind that use of exhaust steam at very low pressure will make a serious difference in the heating capacity of your radiating coils. Suppose, for instance, you have a back pressure of only $\frac{1}{2}$ pound per square inch; then the sensible heat of your steam will be 213° Fahr., while the temperature of your present system with a pressure of 15 pounds is 250° Fahr. Consequently you would require to add 15% more radiating surface to secure present radiating efficiency with exhaust steam under conditions named. You could by use of an automatic back pressure valve, set in exhaust main, maintain a continuous pressure on heating mains, with steam from exhaust from engine, and return all drips to boiler, all surplus steam exhausting into atmosphere. Of course, back pressure on exhaust main would act against engine, but with ample radiating surface this could be reduced to a minimum.

"JAS. JOHNSTON": Your question covers a very wide field; everything depends upon construction of your furnaces, how the hot gases are utilized after leaving combustion chamber, etc. A knowledge of exact conditions, with diagram of boiler and setting, would help us to aid you in solving the problem.

"ONTARIO": (1) Prevention is better than cure; examine your engine thoroughly and find out where oil comes from, then take steps, by use of shields, good oil cups, etc., to have oil placed where intended, and not on the belt. Addition of whitening, etc., finally only aggravates trouble, and if any of it gets into a bearing look out for a hot journal. Get your belt cleaned by a reliable belt manufacturer, and careful attention will prevent further trouble unless your engine is habitually "dirty." In that case cure is almost hopeless. (2) Increasing the speed of an engine

gives more power; decreasing speed, less. Usually engine builders design to get best results both for economy and safety at given speeds, and it is not wise to deviate far from this. (3) An automatic cut-off engine is supposed to adopt its steam admission to its load; consequently a high pressure and light load mean an early cut-off, and in the case of many high speed engines, heavy compression, a too early cut-off, and consequent long expansion is conducive to loss by cylinder condensation caused by the two extremes of temperature. On the other hand, low steam pressure and heavy load means that cut-off will not take place until late in the stroke, and all advantages arising from the use of steam expansively are lost. A steam pressure adapted to the load is the most acceptable, say to cut off at $\frac{1}{4}$, $\frac{1}{3}$ or $\frac{1}{2}$ stroke, according to the economy of your engine. The best pressure is that which gives the most economical point of cut-off. An indicator would be very useful to you, enabling you to determine cut-off with different loads and different pressures, and thus enabling you to decide what pressure is likely to give best results in your particular case.

"SUBSCRIBER": I do not see how you can hope to gain any decided advantage by placing pipes as suggested, unless they are in direct contact with the flue gases. The quantity of heat that would radiate from breeching to water would be very small. Every unit of heat extracted from flue gases reduces the intensity of your chimney draft a corresponding degree. The greater the difference between the temperatures of the external air and internal gases, the greater the intensity of the draft. Any cool substance, whether water or air, in contact with the stack, will act as a condenser and extract heat from internal gases. Suggested pipes placed inside of breeching in direct contact with flue gases is practically the principle of "Green's Economiser," and would briefly have a double effect: 1st, the raising of the temperature of the feed water; 2nd, the lowering of the draft gauge. 1st, by restriction of breeching area for passage of flue gases; 2nd, by reducing the temperature of flue gases. Reduce product of dynamo to electrical energy or horse power expressed in watts:

Ohm's law is $E = C \times W$

Then $115 \text{ volts} \times 250 \text{ amperes} = 28,750 \text{ watts,}$

and $28,750 \div 746 \text{ watts in one h.p.} = 38.5 \text{ electrical h.p.}$

Next find power engine is capable of developing, cutting off at $\frac{1}{2}$ stroke, with, say, a mean effective pressure of 35 pounds to the square inch. This is done by simple formula:

$$\frac{A \times P \times S^1}{33,000} = \text{h. p.}$$

When A = area of piston in square inches.

N = number of strokes per minute.

P = mean effective pressure.

S¹ = length of stroke in feet.

Then $9.5^2 \times .7854 = 70.88 \text{ sq. in. area of piston; and}$

$280 \text{ revolutions per minute} \times 2 = 560 \text{ strokes per minute.}$

$$\frac{70.88 \times 560 \times 35 \times 1}{33,000} = 42 \text{ h. p.}$$

There is, however, a loss of power between the engine cylinder and the terminals of the dynamo, varying in accordance with the conditions under which the dynamo is operated, but which in modern plants should not exceed to per cent., which is about, in your case, the difference existing between generator and engine with a boiler pressure of 80 pounds and an M. E. P. of 35 pounds to the square inch. The method of calculating M. E. P. and H. P. will be fully detailed in educational department in due course.

ANSWERS BY MR. JAMES MILNE.

"ONTARIO": The exhaust steam can be readily used for heating purposes without making any great difference on the back pressure, by having the combined area of the pipes leading to the various departments equal to, if not greater than, the exhaust pipe.

"JAMES JOHNSTON": Don't know what could be done to reduce the temperature of gases. The trouble lies in the design of the boiler.

"ONTARIO": (1) With Armstrong & Sims engines, together with the majority of these high-speed engines, this trouble is very common and hard to get rid of. One remedy, or rather partial remedy, is to use grease, and as little oil as possible. Unless your belt is completely saturated with oil, whitening or chalk should prevent slipping for considerable time. You should not scrape it while running. (2) By increasing speed the power of an engine is also increased. (3) The most economical pressure is from 80 to 100 lbs. for simple high speed engines. The higher the pressure is the less steam is used.

"SUBSCRIBER": A very long length of piping would be required to increase the temperature of your water to any considerable degree. It would reduce your draft a little. If your gases are

only 450, we don't think it would pay you to do it. The horsepower of an engine can be calculated by the following formula:

$$\frac{P \cdot L \cdot A \cdot N}{33,000}$$

Where P = Mean effective pressure,
L = Length of stroke in feet,
A = Area of piston in square inches,
N = No. of strokes per minute.

In your case the unknown quantity is P, which can be arrived at near enough for your purpose, in this manner:

Suppose the engine cuts off at $\frac{1}{3}$ stroke, which is equal to a ratio of expansion of three.

The mean pressure is = Initial absolute press. $\left(\frac{1 + \text{hyp. log of } 3}{3} \right)$

∴ Mean effective press. =

Initial abs. pressure $\left(\frac{1 + \text{hyp. log of } 3}{3} \right)$ - back pressure.

The initial pressure = 80 + 15 = 95, and the back pressure of the engine is non-condensing, say

5 lbs. above atmosphere = 20 lbs. absolute.

Then M.E.P. = $95 \left(\frac{1 + 1.098}{3} \right) - 20 = 46.5$ lbs. = 46.5 lbs.

From this the h. p. of the engine can be calculated.

$$\text{h. p.} = \frac{46.5 \times 1 \times 70 \times 560}{33,000} = 55 \text{ h. p.}$$

To run your dynamo to the load, viz., 250 amperes, at 115 volts, would take, including friction, etc., nearly 50 h. p. Therefore your engine is large enough.

"JAMES MCPHERSON": Oil is not necessary.

ANSWERS BY THE ROBB ENGINEERING COMPANY.

"J. G.": The Barnard system is a very effective and simple system of exhaust heating. Write for particulars to Geo. A. Barnard, 39-41 Cortlandt Street, New York City.

"JAS. JOHNSON": You can reduce the temperature of flue gases by reducing the grate surface or increasing the heating surface of your boiler. The heating surface may be increased by placing in smoke flue a small economizer of the Green type, consisting of vertical pipes between which the gases pass on their way to the chimney, and the feed water by being passed through the tubes is heated to 250 to 300 degrees.

"ONTARIO": (2) Most high speed engines are designed for about a certain speed, at which they will run smoothly and regulate best, but a variation of 25 revolutions above or below the rated speed may be made without any serious disadvantage, provided the governor is properly adjusted. (3) 80 lbs. pressure would be more economical than 50 lbs., provided the work being done is sufficient to require the cut-off to be as late as $\frac{1}{4}$ stroke or later. If the engine is underloaded a less pressure might be more economical in order to prevent too early cut-off and too great expansion. It is not economical to expand more than three or four times in a single cylinder.

"SUBSCRIBER": It would not pay to put water pipes on the outside of your flues. You could use Green's economizer to advantage if you have sufficient draft, but not without. A $6\frac{1}{2} \times 12'$ A. & S. engine running at 250 revolutions should develop about 40 horse power at $\frac{1}{4}$ cut off, and would work up to about 56 horse power at latest point of cut-off. 250 amperes at 115 volts = $\frac{250 \times 115}{746} = 38.5$ electrical horse power; add 25 per cent. for friction

and loss in engine, and dynamo would equal about 48 horse power. The engine should do this without being too greatly overloaded.

ANSWER BY "JAMES."

In answer to "James McPherson," I have been using cylinder oil and some times common machine oil. I don't really know if it is necessary to give it much oil. How about the piston packing being chewed up by it and the valves in your pump, if you have one? There is one thing I would like to know, and that is how to stop that everlasting grunting and groaning in the steam end of elevator pumps. They are nearly all the same when put on elevator work. I know of three different makes, so it is not the makers' fault. I notice that when the pump is going at her speed she is all right, but the minute she slows down that minute she begins to groan and scrape. Would it be any use feeding graphite? But, then, a sight feed would not take it. Pointers will oblige.

SIR,—As I have been thinking of altering my boiler setting, I would like, before doing so, to know what is the generally accepted plan. There are many others like me who do not really know whether their conditions are right or not, and who would be glad of enlightenment on the subject; so to try to benefit others as well as myself, I have thought of asking the following questions, with the hope that superintendents or engineers will give us the sizes as in their plants. Each man looking for the information would therefore be able to pick out his own size boiler, etc., and compare conditions and results. If some of our large engine builders and engineering expert friends could be got to give us their opinions, the time it would take them to do so would not be lost.

What size are your boilers, length, diameter, size of tubes and number of same; how much heating surface and what is h. p. of boiler?

Size of furnace, length, breadth and height from boiler?

Kind of grate bars, shaking or stationary, what air space, and how are bars placed?

Height of bridge wall from boiler, and how built?

Depth of combustion chamber and how it is shaped back of bridge wall?

What should be the ratio between grate surface and heating surface and between tube area and grate (for different fuels)?

What air openings, if any, and where situated, bridge wall or sides of furnace?

What mode of firing and thickness of fire, and what is found to be the most economical rate of consumption per square foot of grate per hour?

How do you bank your fires?

When unable to weigh coals, but passing water through a meter, how much water should a boiler of a given size be able to use and be up to its economical limit? Under that amount we would understand that it was too large for the work required, and over that we would say it was being forced?

What should draft be at chimney and at furnace?

Have you ever used forced draft and with what result?

What should temperature of flue gases be?

What is the efficiency of your boiler?

When wishing to check draft whether would you close damper in flue or close ashpit doors, taking into consideration that when closing damper in flue you choke tubes with soot?

How are your boilers covered in? Does the flue return on top again or do you use top of boiler as a dead flue, i.e., gases get on top but no circulation, or when boiler is bricked in at sides in usual way do you have bricks or other covering lying directly on top, or do you have an air space between boiler and covering?

Have you any arrangement for heating feed water apart from exhaust steam water? If so, explain it.

Do you think it is better to force a boiler for a few hours or cut in another one?

What does a pyrometer cost and would it be of any value to have it?

Besides giving sizes, etc., a few remarks as to the advantages or disadvantages of any of the points would be advisable.

ALFRED O. PEACH.

"INDICATOR" writes: I was thinking of putting on an indicator on my engine, an A. & S. Would some one give me all the sizes for the correct rigging and how to set it up? Please indulge in no generalities, as I have had no experience in this matter. My engine has 12 inch stroke.

SIR,—Would you please ask in your first issue: (1) Whether it is best to run with dirty flues or to run with clean flues and damper, say, half shut. Closing the damper makes sooty tubes. My boiler fully half the time is too large and I cannot brick up grates. (2) Is a return steam trap or an injector the most economical in steam consumption for boiler feeding? (3) I have a steam drum used for drying purposes through which the steam at 50 pounds blows, slightly throttled on discharge side, and I should like to connect it on to a nason trap, if it would work through the following piping: Drum stands 3 feet from floor; discharge pipe would have to dip 30 inches below floor, then rise 3 feet in a length of, say, 10 feet and connect on to another pipe going to the trap. I would put on a check valve just before it connected on to the other pipe.

ONTARIO NO. 2.

"WILLIAM HIGGINSON" writes: "We have a steam plant here driving the electric lights, which is going to be too little for the work we can get for it to do, and we are thinking of putting in storage batteries to carry the peak of the load for about four hours. Can you inform me where any batteries are now in use to carry the peak of the load as above mentioned?"

ANSWER.—We do not know of any plant in Canada using a storage battery to carry the peak of the load. There are several battery plants in use, but none of them are used for that purpose. Henry Morgan, Montreal, and the Toronto University Chemical Laboratory have them, but use them only when the generator plant is shut down.

"T. C. D." Guelph, Ont., asks: "What are the names of the principal slow and medium speed steam engines, slide valves, fitted with fly ball governors, used in England, and what is the most popular governor regulator used in England?"

ANSWER.—There are so many engine builders in England that it is pretty hard to give "the principal" ones. Messrs. John Fowler & Co., engineers, Leeds; Roby & Co., Globe Works, Lincoln; Ransomes, Sims & Jefferies, Limited, engineers, Ipswich and London; and Tangy's, Limited, Birmingham, are among the most prominent. We cannot advise you at present as to the most popular governor.

The Gutta Percha & Rubber Company, West Lodge Avenue, Toronto, have lately installed a 60 k.w. generator, and are wiring their factory for 450 incandescent lamps and 15 arc lamps. All wiring is being done with rubber wire in cleat work. The plant is to be divided into six sections with separate feeders for each section, and having an elaborate switchboard containing switches for each feeder and station instruments. The whole of the work is being installed by Mr. H. F. Strickland, electrical contractor, 35 Adelaide Street East.

TENDERS FOR ELECTRIC LIGHT

Sealed tenders will be received by the undersigned up to noon on MONDAY, NOVEMBER 1ST, 1897, for the furnishing and operation of twenty-nine (29) Arc Electric Light Lamps of twelve hundred candle power each (1,200), on the streets of the Town of Orangeville. Estimates are solicited for a one, two and three year contract. The lowest of any tender not necessarily accepted. For further information apply to

WILLIAM WALLACE,
Chairman Street Lighting Committee, Orangeville, Ont.

SPARKS.

Incorporation has been granted to the Strathroy Electric Co., with a capital of \$20,000.

The Electric Light Company, of Revelstoke, B. C., have their power house in course of erection.

The London Street Railway Company have completed the extension of their road to Pottersburg.

The town council of Almonte, Ont., is being urged by rate-payers to purchase an electric light plant.

The Exeter Electric Light & Power Co., of Exeter, Ont., has been incorporated, with a capital stock of \$15,000.

Messrs. O'Reilly & Murphy, of Ottawa, recently installed an electric light plant, consisting of 130 lights, in the Archbishop's palace in that city.

An explosion occurred recently at the Chambers Electric Light Works, Truro, N.S., by which the new engine was almost completely ruined. None of the employees were injured.

For the preservation of wooden telegraph poles the Bouché process of injecting a solution of sulphate of copper into the pores of the wood is said to prolong their lives to about fifteen years.

The Jenckes Machine Co., of Sherbrooke, Que., shipped last week one of their heavy 50 horse power slide engines, with standard steel tubular boiler, to Desire Thibault, Esq., of East Hereford, Que.

The dam at Magog for the civic electric light plant is completed, and the 50" Crocker water wheel, which is being furnished by the Jenckes Machine Co., of Sherbrooke, is expected to be installed now within a short time.

The Monte Cristo Mining Co., of Rossland, have made a fresh strike, and have ordered a complete new hoisting and pumping plant from the Jenckes Machine Co., of Sherbrooke, which has been supplied from their Rossland stock.

The Great North-Western Telegraph Company, in conjunction with the Spokane & Fort Steele Telegraph Company, have completed the erection of a new telegraph line from Kalispell, Mont., to Warder and Fort Steele, B.C. Other extensions are contemplated in the near future.

Messrs. Ahearn & Soper, of Ottawa, have secured the contract for the telegraph wiring of the Ottawa & New York Railway. The line will extend from Ottawa to Moira, N.Y., and along the cable under the St. Lawrence. The amount of the contract is said to be large.

Water was turned into the flume at the factory of the Boston Rubber Co., at St. Jerome, Que., on the 25th ult. The steel flume, which is 350 ft. long and 6 ft. in diameter, was furnished complete, including a 55" Crocker wheel, by the Jenckes Machine Co., of Sherbrooke, Que.

The power station of the Sherbrooke Street Railway, of Sherbrooke, Que., is rapidly nearing completion, and the turbine plant being installed by the Jenckes Machine Co. is also about completed. Mr. Burke, the president, states that they expect to be in operation by the 15th of October.

Hunter & Oliver, solicitors, of Victoria, B.C., give notice of application to parliament for the incorporation of a company to construct a narrow gauge railway from Portland Inlet to Teslin Lake, with power to build bridges, telegraph and telephone lines, etc., and to supply light, heat and power.

The Consumers' Cordage Co., Limited, of Halifax, N. S., have for some time been considering the adoption of electricity as a motive power for operating their machinery. The manager of the company states that owing to the cost of the machines, they have concluded that it is not economical at present.

The Kootenay Electric Co., of Kaslo, B.C., are utilizing the new water power to generate electricity, and have placed an order with George C. Hinton & Co. for a 150 k.w. "S. K. C." generator complete, with transformers and motors. The latter firm are agents in British Columbia for the Royal Electric Co.

The Parry Sound Electric Light Company held their annual meeting on September 7th. Directors were elected as follows: Messrs. S. Armstrong, William Beatty, Dr. Walton, W. H. Pratt, J. J. Joffille, J. F. Mossley and Dr. J. R. Stone. The company have now over 900 private lights and 40 street lights under contract.

The Bridgewater Power Co., of Bridgewater, N. S., have lately been reconstructing and enlarging their electric light plant, and have replaced their three wire system by an alternating current system, for which purpose they have purchased a 40 k.w. "S. K. C." two-phase generator from the Royal Electric Co., and 600 light capacity in transformers.

The total length of the world's telegraph system is given as 4,608,921 miles, exclusive of 180,440 miles of submarine cables. Of this, Europe has 1,764,790 miles; Asia, 310,685 miles; Africa, 99,419 miles; Australia, 217,479 miles; and America, 2,515,348 miles. These figures are given by United States Consul Germain, of Zurich, to the State Department.

The Electric Light Company at Dartmouth, N. S., are introducing the meter system. The rates for lights so supplied will be 1½ cents per one thousand watt hours, or ½ cent less if meter is owned by consumer. Where bills are less than \$2.50 a month a rental of 25 cents a month will be charged for the meter when it is supplied by the electric light company.

At a recent trial on the Ottawa river a new invention, called the submarine searchlight, proved a decided success. The searchlight showed the bed of the river plainly for a circumference of 50 feet; and at a depth of 35 feet objects could be distinguished

without any difficulty. The object of the inventor is to enable divers to perform their work with accuracy and to trace lost treasure. It is especially adapted to assist the workers on wrecked vessels lying underneath the water at a great depth. The inventor is Mr. Joseph de l'Etoile.

Mr. Geo. Eastbrook, who is about taking his departure for Delagoa Bay, South Africa, where he is erecting flouring mills and other industries for a wealthy syndicate of Canadians, is taking with him a complete electric lighting plant. The apparatus and material complete are being purchased from the Royal Electric Co. This we believe is the first instance where a Canadian electric lighting plant has been sold for service in the antipodes.

From a carefully prepared table of statistics published in a German contemporary it appears that 80 per cent. of the continuous current stations in that country are provided with accumulators, the total output of which is 31 per cent. of the whole power of these stations. Notwithstanding such figures as these, there are many American electrical engineers who still doubt the advisability of installing accumulators in connection with central stations.

The water power of the Shawenegan Falls, on the St. Maurice river, in Quebec, was recently sold by the Crown Lands Department to Mr. David Russell, of Montreal, who is said to represent a strong syndicate intending to manufacture calcium carbide for acetylene gas. One of the conditions of the sale was that the purchasers should expend \$2,000,000 within eighteen months on the erection of buildings and plant and in developing the water power, and a further \$2,000,000 within the next two years.

Wireless telegraphy is occupying a good deal of attention just now, and to accompany the encouraging reports from Mr. Tesla of his advances and success with new apparatus for such work, we note the statement from Marconi that he is about to signal electrically without wires from St. Paul's Cathedral, London, to the Eiffel Tower, in Paris, a distance as the crow flies of perhaps 150 to 200 miles. It will be interesting to see what comes of all this movement, which may well betoken a new advance in electrical discovery and invention.

According to a London exchange, a report on the electrical and allied trades in Cape Colony is being prepared by Mr. A. P. Trotter, honorary correspondent for that district of the London Chamber of Commerce. In his report, Mr. Trotter will allude to the prospects of employment for electrical engineers in South Africa. He desires it to be made known that no electrical engineers should go to South Africa at present unless they have secured definite appointments before sailing. Many competent electrical engineers in that country are now unable to find employment.

The Nelson Electric Light Company, of Nelson, B.C., have declared a dividend of 12 per cent. for the financial year just closed. This company have elected directors as follows: John Houston, president and manager; John J. Malone, vice-president; J. H. Matheson, secretary; John Johnson, treasurer; J. Fred Hume, J. A. Mara and John Hamilton, directors. The city council has recommended that the offer of the company to light the streets for a period of five years be accepted, provided they agree to dispose of the plant, franchise, etc., to the city within one year at a price not to exceed \$40,000.

The interest in the electric railway question in England has extended as far as the question of trolley car etiquette, as will be seen from this quotation from a London contemporary: "We are told that another peculiarity of the American street cars is that ladies are not allowed to stand in them. When a lady enters a crowded car a seat is promptly vacated for her convenience. No doubt this is sometimes done even in England, but rarely in the same way, with the result that while here it is recognized as courtesy and thankfully acknowledged, there it is taken as a right, for which no thanks are necessary."

The Willow Creek Gold Mining Company, of which Mr. E. Todd, of Brantford, is president, are about to undertake the construction of an electric railway from Bell City to Island Bay, on Bad Vermilion lake. The railway will be four miles in length, and will be extended as occasion demands. It is proposed to utilize the water of the falls on the Vermilion river and Grassy lake for power purposes, and to put in sufficient electrical machinery to operate a custom stamp mill, as well as the railway. Mr. M. W. Hopkins, electrical engineer for the company, will shortly make a report on the water power.

Among the visitors to British Columbia recently were Messrs. George G. Ward and S. S. Dickenson, general manager and superintendent respectively of the Commercial Cable Co., of Canoe, N.S., where the cable connects with the land line. Regarding the Australian cable question, Mr. Ward stated that it would undoubtedly be built at an early date, and in his opinion its construction was warranted. If Vancouver was the terminus, as undoubtedly it would be, he stated that his company would probably work in connection with the Australian cable, and for that purpose he had examined the proposed landing place and secured all the information possible on the subject.

The Hull Electric Company and the Ottawa Electric Company are engaged in a legal combat over the privileges of electric lighting for the city of Hull. The former company claims to have an absolute and exclusive privilege for lighting the city for 35 years, and asks the Ottawa company to remove their poles and electric apparatus and to pay them \$20,000 damages. On the other hand, the Ottawa Electric Company states that the corporation of Hull, as far back as 1887, granted the company permission to erect poles and furnish electric lighting, and that the by-law passed by the corporation in 1894 granting the privilege to the Hull Electric Company does not affect their rights.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his study's without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obscure and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of,

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of,

SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.

ROLLER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMSON.

[ARTICLE VI.]

SAFETY VALVE CALCULATIONS.

(Continued.)

SPRING-LOADED SAFETY VALVES.

The questions of most importance to the practical working engineer regarding spring-loaded valves are: Size of steel from which the spring shall be made; required inside and outside diameter; compression required to have given effect.

A standard spring, if made of the best square steel, contains an area of .25 of a square inch, the inside diameter is exactly two inches and outside diameter three inches; it contains thirteen complete coils, and measures exactly eleven and one-half inches in length. The working load is assumed at 600 pounds, one-sixth of its breaking load when hardened to a temper just sufficient to break it; at this load it should deflect exactly one inch.

Example (1): A safety valve 4 inches in diameter has a spiral spring made of square steel 3" diameter outside and .25" thickness of steel; what will be the pressure per square inch?

Formula:

$$\frac{12,000 S^2}{d} = \text{whole pressure on valve.}$$

Where S = thickness of steel in inches,

d = diameter of spring from centre to centre of steel,

12,000 = constant used for square steel,

8,000 = constant used for round steel.

$$\text{Then, total weight} = \frac{12,000 \times .25^2}{2.5} = 600 \text{ pounds.}$$

Diameter of valve is given as 4 inches. Area of valve then $= 4^2 \times .7854 = 12.5664$ square inches. \therefore pressure per square inch $= 600 \div 12.5664 = 47.7$.

The foregoing is the fundamental principle to connect the loading of the spring valve with that of a direct weighted valve, and from it may be obtained both the proper thickness of steel to be used and the proper inside and outside diameters of the spring.

Example (2): What must be the outside diameter of a spiral spring for a safety valve 5" in diameter? The pressure to be carried is 50 pounds, and the diameter of the steel is $\frac{3}{4}$ inch.

Formula:

$$d = \frac{8000 S^2}{W}$$

Where d equals as before the mean diameter of the spring, S thickness of steel, W the whole weight on the valve, then

$$d = \frac{8000 \times .75^2}{5^2 \times .7854 \times 50} = \frac{3360}{981.75} = 3.42 \text{ inches.}$$

This, however, is only the mean diameter, or the diameter from centre to centre of steel. Therefore, the diameter of the steel must be added to this to get the outer diameter.

$$\therefore \text{outer diameter} = 3.42 + .75 = 4.17 \text{ inches.}$$

Example (3): The diameter of a spring loaded safety valve is 5 inches, gauge pressure 60 pounds, and mean diameter of a spiral spring 5 inches, what must the area be for square steel, also the length of each side, the area and diameter for round steel, and the inside and outside diameter of each spring.

The Steamboat Inspection Act adopts the Board of Trade rule for the determination of the required size of steel under the following formula:

$$\frac{W \times d}{c} = S$$

S = Side or diameter of steel in inches.

W = Load on spring in pounds.

d = Diameter of spring from centre to centre of steel.

c = 12,000 for square steel.

c = 8,000 for round steel.

Then we require to multiply total load in pounds by mean diameter in inches, and divide by either constant 12,000 or 8,000, as the case may be, and cube root of quotient equals diameter of steel.

First find what w of formula represents, by multiplying area of valve by pressure per square inch.

$$\therefore W = 5^2 \times .7854 = 19.635 \text{ sq. in. area.}$$

$$19.635 \times 60 = 1178.1, \text{ total weight.}$$

$$1178.1 \times 5 = 5890.5.$$

$$\text{Then } \sqrt[3]{\frac{5890.5}{12000}} = \text{diameter for square steel.}$$

$$\text{and } \sqrt[3]{\frac{5890.5}{8000}} = \text{diameter for round steel.}$$

$5890.5 \div 12,000 = .49$, and $\sqrt[3]{.49} = .788$ inches length of each side for square steel.

$.788 \times .788 = .62$ square inches area of square steel.

$5890.5 \div 8000 = .736$, and $\sqrt[3]{.736} = .9$ inches diameter of round steel.

$.9^2 \times .7854 = .63$ square inches area of round steel.

For a spring constructed of square steel our dimensions then become:

Mean diameter of spring (i.e., from centre to centre of steel) = 5 inches
Outside diameter of spring equals 5 inches plus size of steel = 5.788 inches
Inside diameter of spring equals 5 inches minus size of steel = 4.212 inches
Size of steel = .788 inches
Area of steel must contain62 sq. in.
And for a spring constructed of round steel, dimensions are as follows, viz:

Mean diameter of spring = 5 inches
Outside diameter of spring is 5 in. + .9 = 5.9 inches
Inside diameter of spring is 5 in. - .9 = 4.1 inches
Diameter of steel wire = .9 inches
Area of steel must contain63 sq. in.

With a standard spring before us it is easy to determine the required sectional area of any steel spring when fundamental principles of this formula are understood.

As we are given the whole of the dimensions of a standard spring made of spring steel, we can determine the sectional area of a square spring by the following process:

As given weight is to required weight so is given sectional area to required sectional area.

For example, let us compare our determination of sizes for a square spring with a standard spring; our question then becomes: As 600 to 1178.1 :: .25; required area.

$$\text{Then } 1178.1 \times .25 = 294.5.$$

$$294.5 \div 600 = .49, \text{ sectional area of spring at a load of } 1178.1 \text{ pounds.}$$

$\sqrt[3]{.49 \times .7854} = .788$ required size of steel to comply with standard spring. All other dimensions of the spring will change in same proportion.

With spiral springs then there is to the practical operating engineer the important question of determining the increase in pressure by compression or the decrease in pressure by reducing the com-

pression, or the change similar and corresponding to the graduation of a lever safety valve.

The formula for this is $\frac{W \times d^3}{S^4 \times G} \times n = \text{total compression}$.

Where W is the total weight pressing upwards against the valve in pounds

d = mean diameter of spring

S is thickness of steel in sixteenths of an inch

G is constant 30 for square steel

G is constant 22.8 for round steel

n is number of coils in spring.

Example (3): A spring loaded safety valve 5 inches in diameter is set for a gauge pressure of 90 pounds, but owing to weakness of boiler, pressure must be reduced to 60 pounds; the outer diameter of spring is five inches and spring is made of $\frac{3}{8}$ inch steel with 15 coils; what compression must be given to produce required pressure starting with spring slack?

$\frac{W \times d^3}{S^4 \times G} \times n = \frac{5^2 \times .7854 \times 60 \times 4\frac{3}{8} \times 15}{10^4 \times 30} = 4.932$ inches, total compression required.

From this formula may be deduced the number of coils required, so that a given pressure shall require a given compression, or the load on the valve with a given compression, the diameter of coil or thickness of steel, if the other quantities are given.

The most important of these to the engineer is the determination of the number of coils required; the change in pressure by a given change in compression, and also the determination of the total weight bearing down against the valve or the weight required to lift it off its seat when dimensions of spring and compression are known.

To determine the number of coils required to balance a given pressure with a given compression, we construct from above formula the following:

$$C \div \frac{W \times d^3}{S^4 \times G} = N.$$

Where W, d^3 , S^4 , G and N have same values as in last formula, and C equals compression in inches, result will be required number of coils.

To determine pressure at which valve will blow off, with a spring of given dimensions and given compression.

Formula:

$$\frac{S^4 \times G}{a \times d^3 \times N} \times c = P, \text{ pressure at which safety valve will blow off.}$$

a equals area of valve in inches.

To determine total weight holding the valve in place, with a valve of given dimensions and given compression.

Formula:

$$\frac{S^4 \times G}{d^3 \times N} \times c = W, \text{ total weight holding valve down.}$$

Reference has been made to every safety valve requiring a given orifice or opening to allow of free passage of steam, so that increase in boiler pressure shall not take place. It is at the same time just as important that area of valve should not be too great to allow the free discharge of steam.

For steam above 10 pounds pressure above the atmosphere, the weight of steam that will escape into the atmosphere through an opening one square inch in area is, in 70 seconds, just equal to the pounds in the absolute pressure of the steam per sq. inch.

Example: To what height must a 5 inch safety valve rise from its seat to allow steam to escape at the rate of 9,200 pounds per hour, if the pressure on the boiler is 75 pounds per sq. inch above the atmosphere.

Since the weight of steam that will escape per square inch in 70 seconds is equal to gauge pressure plus atmospheric pressure, we proceed to find the weight of steam escaping from one sq. in. per hour.

Gauge pressure, 75
Atmosphere, 15

90, absolute pressure.

Then as 70 : 60 :: 90 : to the weight of steam escaping per minute.

Then, $\frac{60 \times 90 \times 60}{70} = 4628.5$, pounds of steam per hour per sq. in.

Then as 4628.5 : 9,200 :: 1 sq. inch to required area,

$\frac{9200}{4628.5} = 1.98$ square inches of escape required.

Then if required area is divided by circumference of valve in inches, result will be distance valve will be required to raise from its seat to allow the escape of 9,200 pounds of steam into the atmosphere.

3.1416

$\frac{5}{15.7080} = \text{circumference.}$

15.7080 = circumference.

15.7081.98000.126 of an inch lift.

$\frac{15708}{41920}$

$\frac{31416}{105040}$

$\frac{94248}{10792}$

.126

$\frac{8}{1.008} = \text{Lift must be } \frac{1}{8} \text{ of an inch.}$

1.008 = Lift must be $\frac{1}{8}$ of an inch.

From this, weight of steam escaping into the atmosphere from any orifice may be determined.

OHM'S LAW.

As stated in our last, and following out the principles therein set forth, the current in a conductor varies directly as the pressure or potential at the terminals, and inversely as the resistance of the conductor. From this then we get the following formula:

$$(1) \quad C = \frac{E}{R}$$

This is known as Ohm's law, and is in continual use in the study of electrical engineering.

In equation 1 we have formula for C, when both E and R are known. It consequently follows that we require but a simple transposition in the terms of our algebraic equation to find any of the quantities E, R or C when any two of them are known.

$$(2) \quad \text{Thus } R = \frac{E}{C}$$

which simply means that the resistance is equal to the electromotive force (E.M.F.) divided by the current, and

$$(3) \quad E = R \times C$$

meaning that the E.M.F. is equal to the resistance multiplied by the current.

From these equations it will be readily seen that if any two of the quantities E, R or C are given, the third may be found from one of the three equations, and that they are all based on the same law.

The energy in an electric circuit is equal to the pressure or potential at the terminals of the conductor multiplied by the current flowing through the conductor or circuit, and can be expressed in formula as follows:

$$(4) \quad W \text{ or watts} = E \times C$$

Here we have a simple formula for the purpose of finding the electrical energy of a circuit or generator when E and C are known.

But it frequently occurs that we must find W when any two of the units E, R or C are known. In equation (3) we have $E = R \times C$. With this information before us let us substitute this value of E in (4); we then get

$$W = (R \times C) \times C \text{ or}$$

$$C^2 \times R = \text{watts}$$

Again in equation (1) we have

$$C = \frac{E}{R}$$

Substitute this value of C in equation (4), and we get

$$W = \left(\frac{E}{R} \right) \times E \text{ or}$$

$$\frac{E^2}{R} = \text{watts}$$

Following out then the general principles laid down, we get these formula for the determination of the electrical energy in any circuit when any two of the units E, R or C are known, or in other words the capacity of any circuit or dynamo to do work.

In our mechanical studies we establish the important fact that the energy cannot be destroyed, and that it will occur either as mechanical force or heat, or both.

And when an electrical current is passed through a wire or conductor a certain amount of electrical energy is lost as such, but makes its appearance as heat. Consequently the amount of heat generated must be equal to the electrical energy lost, and must therefore be measured in watts.

Formula: $W = C^2 \times R$ is the formula generally used for the computation of heat generated in a circuit. If the resistance of a circuit and current flowing is known it is only necessary to multiply the resistance of the circuit by the square of the current to find electrical energy lost in transmission and appearing as heat.

Mr. C. H. Rust, assistant city engineer of Toronto, attended the recent convention of Telephone Superintendents at Detroit. Mr. Rust gives it as his opinion that it would be impossible for any company to compete with the Bell Telephone Co. in Toronto so long as they maintain their present rates.

ELECTRIC RAILWAY DEPARTMENT.

LARGE ENGINE FOR STREET RAILWAY SERVICE.

At the William street power house of the Montreal Street Railway Company there is now running in regular service the large engine recently built for the company by the Laurie Engine Company, of Montreal. Owing to the dark location of the engine, the photograph from which the accompanying illustration was made was not as good as was desired. This engine is said to be the largest and most powerful electric generating engine that has ever been built on this continent. It is of the horizontal cross compound Corliss condensing type, provided with tail rods and back end cross-heads and guides, for the purpose of supporting the weight of pistons, thus relieving the cylinders entirely of this weight and consequent wear (which is the only objection to the horizontal engine as compared with the vertical). This is obtained as follows, viz.: After the pistons are fitted, the rods are supported on points representing the position of the cross-head at either end, the deflection of rod due to weight of piston accurately measured; thus the

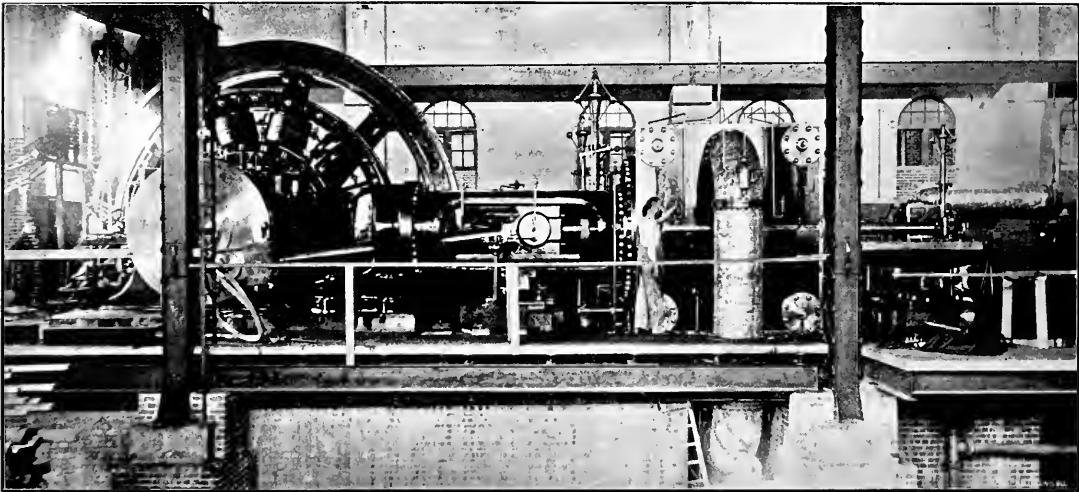
the same time presenting a large bearing surface on the foundation. The main bearings supported by these frames are two feet in diameter and four feet long, the bottom sections (which take the weight of wheel, shaft and generator) of which are water-jacketed.

The air pump is of the single acting, vertical type, and is driven direct from the steam piston rod. The circulating pump is driven from one end of the air pump shaft. The surface condenser is of the Wheeler type.

The engine is designed to work with a pressure of 160 lbs. of steam, at which pressure 4,500 h.p. can be developed. The whole engine weighs 400 tons, and makes a smooth, silent-working machine.

ELECTRIC RAILWAY FRANCHISE IN JAMAICA.

ONE of the largest foreign enterprises that Canadians have yet undertaken is shortly to be carried out in Jamaica, through the efforts of Mr. W. B. Chapman, of Montreal. This gentleman has for some time been negotiating for an electric tramway franchise, and has at last secured a charter from the government to build twenty-five miles on the island, in the vicinity of Kingston, which, it is estimated, will cost half a million dollars. Associated with him are Messrs. F. S. Pearson, of the Metropolitan Street Railway, New York, and Mr. B. F. Pearson,



4,500 H.P. LARGE ENGINE IN POWER HOUSE OF MONTREAL STREET RAILWAY COMPANY.

piston rods are given a permanent deflection equal to that due to weight of pistons. In this way the piston rods are practically straight when supporting full weight of piston. The dimensions of the cylinders are as follows, viz.: High pressure, 36 inches diameter; low pressure, 64 inches diameter and 60-inch stroke. Both cylinders are steam jacketed throughout.

The valve motion on each cylinder is so arranged and operated that steam may be cut off at any point up to seven-eighths of the stroke. The governor controls the valve motion on both cylinders. An auxiliary governor is provided of same design as the regulator, which is attached to a stop valve in such a manner that should an accident occur to the regulator which would allow the speed of engine to be increased to per cent., the auxiliary governor would close the stop valve and thereby stop the engine.

The fly-wheel is 24 feet in diameter, built in ten sections, and weighs about 100 tons. It is secured to a shaft 26 inches in diameter in centre; 24-inch bearings, weighing 21 tons. The wheel was turned on its own shaft, running in its own bearings on the lathe, and therefore runs perfectly true.

The main bearings or frames are enormous castings weighing over 27 tons each, and so designed that the weight of metal is directly in the line of strain, and at

of the Halifax, N. S., Tramway Company, and the enterprise will be known as the West India Electric Company. A large power house will be built on the foreshore, and electric lighting will also be taken up. The contract has already been given to a Canadian firm, and everything entering into the construction and equipment of the road will be Canadian except the rails. Concerning the venture, Mr. Chapman says: "For some years this has been a hobby of mine, my attention being first drawn to the matter in 1890. Since then I have been several times to the island, but the old street car company, which has earned large dividends for 20 years, was too influential and barred me out. This year I went down in January, and arranged to buy the old road's rights and assets at a fair price, so gaining a decided advantage in tendering. Then I had to get their general 'Tramway Law' amended in many respects to insure our charter being satisfactory when obtained. The next step was to get an act of incorporation passed allowing us to build and operate tramways or generate electricity and distribute it 'for any useful purpose.' This you see allows us to take up electric lighting and telephone as well, and eventually will give us the entire electrical business on the island, which has 700,000 inhabitants in a very small area. Our troubles were not over then, because a Boston company was competing with us for the 'license' from the Governor, which was still necessary to enable us to use our charter. Both parties appeared daily for a week before the Privy Council, and argued their respective cases. The Boston people offered 'penny fares,' but we objected to consider this, and gained our point on general superiority. We have two districts (in city and suburbs) 4 cents each, that is, a maximum of three miles for 4 cents or six miles for 8 cents. Everyone will ride at these rates. We serve immediately about 80,000 people, and will have twenty miles of road in operation within a year, meantime working the horse cars. Only open cars will be required, as the climate is like our July all the year round, excepting May and November, when it rains. We can lay coal down under \$4 per ton, and wages and working expenses are very low."

SPARKS.

The Electric Light Company at Kat Portage, Ont., are erecting a new office building.

The town of Dartmouth, N. S., is at present considering the renewal of its electric lighting contract.

The capital stock of the Halifax Street Railway Company has been increased from \$600,000 to \$800,000.

A gentleman named Baumgarten is said to be negotiating the construction of an electric railway at Brockville.

The announcement comes from Paris that the Auto-Mobile Club is organizing a monster race of motor cars from Paris to St. Petersburg.

Mr. Fowler, on behalf of a syndicate, is still endeavoring to secure the construction of an electric railway from Lanark to Carleton Place.

The Montreal Park & Island Railway Company held their annual meeting last month, at which the old board of directors was re-elected.

Messrs. A. Bouin, Louis Martin and F. X. Drolet, of Quebec, have been appointed provincial examiners of boiler inspectors for the province of Quebec.

The Montreal Street Railway Company closed its business year a fortnight ago, and the total receipts are shown to be \$1,313,632.84, an increase of \$80,226.07 over last year.

The capital of the Quebec Street Railway Co. is to be increased from \$320,000 to \$400,000, thus enabling the company to complete without delay the whole line intended to be built.

Mr. D. Lamont, manager of the Palmerston electric light plant, states that he finds the ELECTRICAL NEWS very interesting, and considers it as a necessary part of every well equipped plant.

At the annual meeting of the Ottawa Car Co., held last month, directors were elected as follows: T. Ahearn, president; P. Whelan, W. W. Wylie, J. W. McKee, and William Scott.

The Vernon & Nelson Telephone Co., of which Mr. H. W. Kent is superintendent, have commenced the construction of a metallic circuit long-distance telephone line between Nelson and Trail, B. C.

On the 9th ultimo a by-law was carried by the township of King granting a bonus of \$12,000 to the Aurora & Schomberg Railway Co. It is proposed to commence the work of construction in the spring of 1898.

The St. John Street Railway Co. have lately received two new vestibule cars from the Ottawa Car Co. They are said to contain several improvements, including electric buttons on either side of each window, electric heaters, etc.

The Sherbrooke Electric Railway Co. have completed their line from the city limits to the end of Lennoxville. Mr. Mylon, of the Canadian General Electric Co., is looking after the company's interests in connection with the construction of the road.

The city of Montreal has entered an action for \$21,000 against the Montreal Street Railway Co. The city claims that it is entitled to receive a percentage of the receipts taken by the company in the suburban municipalities, while the company contends that it is bound to account only for the receipts within the city limits.

Mr. A. J. Corriveau, of Montreal, has lately returned from a trip over the proposed route of the Montreal Southern Counties Railway. It is Mr. Corriveau's intention to construct the line through Chambly, where the motive power will be obtained. The route embraces St. Johns, St. Alexandria, Bedford, Cowansville, Knowlton, Sherbrooke, Lennoxville and other towns.

John Inglis & Son, of Toronto, have obtained a verdict of \$700 against the Hamilton, Grimsby & Beamsville Railway Co. The company purchased a flywheel for an engine from Messrs. Inglis & Sons, but claimed it was defective and refused payment. The plaintiffs claimed that it was made according to contract and passed by the company, and were awarded judgment as above.

Mr. J. B. Griffith, manager of the Hamilton Street Railway Co., has become financially embarrassed. At a meeting of creditors a statement was presented showing assets of \$48,500, consisting of shares in the Hamilton Street Railway Co. The liabilities amount to \$47,127, of which \$45,227 is secured by the hypothecation of the shares. It is probable the estate will be wound up.

There appears to be friction between the Hull Electric Railway Co. and the management thereof. A short time ago Mr. G. W. Seguin, who was acting as secretary-treasurer, retired from the company, and now it is announced that Mr. H. B. Spencer, superintendent of the road, will probably resign, owing to a desire on the part of the company to reduce expenses. Mr. Spencer was engaged about one year ago as superintendent for five years, at a salary of \$3,000 per year.

The Engineering News states that a contract has been signed by the Southern California Power Company for an 80-mile transmission, which is the longest distance on record, the next one to it being 36 miles for the Salt Lake City plant, in which only one-fourth the power is transmitted at one-third the line pressure used on the Niagara Falls-Buffalo transmission. The power station is 12 miles from Redlands; there will be four three-phase generators of 750 k.w. each, directly connected with impact turbines; 250-k.w. transformers will raise the pressure to 33,000 volts.

It is reported that the Belgian government have decided upon trying electric locomotives on the ordinary state railways. The first experiment is to be made between Brussels and Tervueran, a distance of nine miles. The accumulator system is to be adopted. The accumulators for this service will weigh 12 tons, the electric motors and appliances to tons, and the cars, which will carry 80 passengers, 20 tons. The charging of the accumulators occupies one hour for every eighteen miles of running power, but are capable of being charged for seventy-two miles of operation. The motors are to be compound wound and the pressure of current about 500 volts. The success of the trial will be watched with much interest.

TRADE NOTES.

The Foley Mines, Seine River, Ont., are now installing two 100 horse power steel boilers, built by the Jenckes Machine Co., of Sherbrooke.

Mr. C. B. McAllister, of Peterboro', is lighting his new mill by electricity, and has placed an order for the dynamo and fixtures with the Royal Electric Company.

Mr. H. Corby, of Belleville, is lighting his distillery and warehouses with electricity, and has placed his order for the dynamos, etc., with the Royal Electric Company.

D. Champoux & Bro., Disraeli, are installing an electric lighting plant, and have purchased for this purpose a 30" Crocker turbine from the Jenckes Machine Co., of Sherbrooke, Que.

The Galvanic Battery Works Company, of Toronto, in their new catalogue, devotes considerable space to a description of electro-neurotic apparatus for use in the treatment of spinal and other diseases.

The Hawthorne Woolen Co., of Carleton Place, have recently enlarged their premises, and are lighting them throughout with electricity. The contract for electrical apparatus has been awarded to the Royal Electric Co.

The Owen Sound Portland Cement Co., of Shallow Lake, have purchased an electric plant from the Royal Electric Co., and will have the same operating in a very short time. It is their intention to work twenty-four hours per day during the season.

The 30-stamp mill at the Sultana Mines is almost ready to commence operations. This mill is probably the most modern one in the district, and the complete plant with which Mr. Caldwell is equipping the property was furnished by the Jenckes Machine Co., of Sherbrooke, Que.

The Old Ironsides Mine at Greenwood, B. C., have got their new plant, which was furnished by the Jenckes Machine Co., of Sherbrooke, Que., into position, and are now about ready to ship ore. This property is expected to enter the list of dividend payers within the next few months.

In the Machinery Hall at the St. John Exhibition the Robb Engineering Company, of Amherst, N.S., exhibited one of their well-known 40 horse power side crank engines. A railing surrounded a stage, upon which the engine was set, thus forming an ideal engine room. The exhibit was in charge of Mr. J. J. Porter.

The Goldie & McCulloch Company, of Galt, Ont., exhibited at the St. John Exhibition one of their Ideal engines, for which engine is said to make a great saving in oil, using as it does one they have the exclusive right of manufacture for Canada. This oil cup, and is the only self-oiling engine built in the Dominion.

The Robb Engineering Company, Limited, have received an order for three tandem compound engines, side crank type, for export to Spain. These engines are to be direct connected to electric generators, and were ordered by an English engineering firm who are building electric tramways at Barcelona and Madrid.

The Dominion Paper Company, extending and enlarging their mills at Kingsley Falls, Que., have placed an order with the Jenckes Machine Co., of Sherbrooke, for two of their 30" Crocker special turbine wheels. These wheels are mounted on one shaft, set horizontally in a steel case, thus doing away with the gearing and attendant evils.

The Cockshutt Plow Co., of Brantford, have bought additional premises, and are doubling the capacity of their works. Among the important changes is the substitution of electricity for gas. They have placed their order for a 30-k.w. generator and 250 light installation with the Royal Electric Company. The generator is to be of the "S. K. C." two-phase type, wound to deliver 110 volts direct to mains. This system for isolated lighting is a radical departure from the old lines, and is the second instance in Canada where it has been placed in use for factory lighting.

The Thompson Electrical Company, of Hamilton, Ont., report sales of their "T. & T." are lamps to the following: The Sarnia Gas & Electric Co., Stratford Gas & Electric Co., Guelph Gas & Electric Co., St. Thomas Gas & Electric Co., Preston Electric Light Co., Gananoque Electric & Gas Light Co., Maatoba Electric & Gas Light Co., Wallaceburg Electric Light Co., Hamilton Electric Light & Power Co., Niagara Falls Electric Light & Power Co., Welland Electric Co., Woodstock Electric Light & Power Co., City of Windsor, Ont., Montreal Rolling Mills Co., Ontario Rolling Mills Co., John Bertram & Sons, Garrioch, Godard & Co. A complete 100 are light plant, including dynamos, lamps and circuits, has been sold to the city of Chatham, Ont., for lighting its streets.

PERSONAL.

Mr. Karl Wildern, inspector for the Bell Telephone Company, was recently married at London, Ont., to Miss Wilkins.

At Victoria, B. C., recently, Mr. Robert W. Hurray, of the British Columbia Electric Railways, was married to Miss Williams.

The resignation is announced of Mr. William Bathgate, who for the past twelve years has been manager of the Winnipeg Gas and Electric Company.

Mr. J. A. Culverwell, formerly with the General Electric Co. at London, Ont., has received the appointment of local manager for Toronto and Central Ontario for the London & Lancashire Life Insurance Company.

RAPID TELEGRAPHY.

PROF. A. C. CREHORE and Lieut. G. O. SQUIER, U. S. A., in a paper read before the April meeting of the American Institute of Electrical Engineers, entitled "The Synchronograph: A New Method of Rapidly Transmitting Intelligence by the Alternating Current," describes a new method of rapid telegraphy. The transmitter consists of a mechanism for opening an alternating circuit at the exact instant when zero value is reached, and keeping it opened during one or more alternation; one or more half waves may thus be omitted according to the requirements of the telegraphic alphabet. By means of a perforated paper band corresponding to the message to be sent, the half waves are omitted in the proper order. The receiver rests on the principle that if a ray of polarized light is passed through liquid carbon bisulphide or one of a number of other substances, the plane of polarization is rotated by any change in value of a magnetic field set up by a coil surrounding the liquid—that is, by any change of current in the coil. This principle is utilized to register the current from the transmitter, by photographic means, the suppression of the half waves above referred to being thus registered at the receiving end of the line

in the form of a record comparable to that printed on a tape by a Morse receiver. The transmitter may also be used in connection with a chemical receiver, such as the Delany. In experiments no difficulty was experienced in obtaining records with the use of a frequency of 545 periods per second, which corresponds to a transmission of between three and four thousand words per minute.

Messrs. A. P. McLaurin & Co., of Lachine, Que., are about to light their factory by electricity. The order for the dynamos and material has been given to the Royal Electric Co.

The Perth Waterworks Co., of Perth, Ont., have decided to do their pumping by electricity and also to light the town of Perth. For this purpose they have placed their order with the Royal Electric Co. for a 150 k.w. "S.K.C." two-phase generator, from which will be driven the pumps by two-phase motors, the balance of the capacity of the machine being used for lighting and power to be furnished in Perth. A more extended description of this plant, which is rather unique, will appear in the next issue of this paper.

SADLER & HAWORTH

FORMERLY

ROBIN, SADLER & HAWORTH

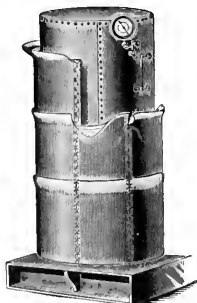
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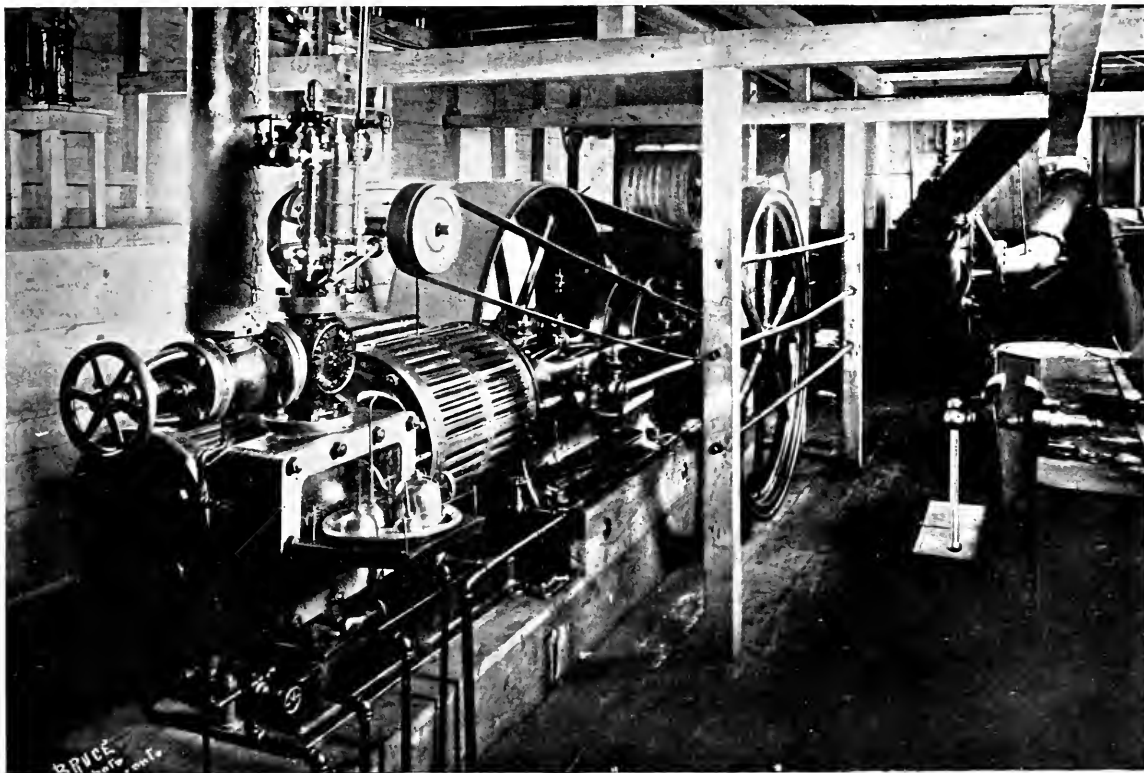
NO. 11.

HYDRAULIC DREDGE FOR THE CITY OF TORONTO.

LAST year the city council of Toronto made an appropriation of \$18,000 for the construction of an hydraulic dredge. The plans therefor were prepared by Mr. C. H. Rust, assistant city engineer, and the work of building awarded to Messrs. Medlar & Arnot. The dredge is capable of excavating to a depth of 16 feet, and is

hoisting and lowering the cutter frame and operating the swinging lines. The dredging pump is of the 12 inch centrifugal type.

In the engine room, a view of which is presented herewith, are to be found engines of the horizontal compound type, 10 × 17 × 15 inch stroke, of ample proportions for high speed and continuous running, and designed to operate at a speed of 170 to 200 revolutions,



ENGINE ROOM OF HYDRAULIC DREDGE BUILT FOR THE CITY OF TORONTO.

fitted complete with all necessary machinery for manipulating the material and feeding the cutter head continuously and uniformly over the bottom. The hull is 90 feet long, 28 feet wide and 6 feet deep, with two bulk heads the entire length. The cutter frame is of steel, and the dredge is also fitted with a rotary steel cutter head, 48 inches in diameter at the base, 30 inches at outer end and 36 inches long.

A pair of duplex hoisting engines, 8 × 12, with three drums and necessary attachments, are placed on the forward deck for the purpose of driving the cutter head,

the indicated horse power being from 75 to 125. The boiler is of the locomotive type, 72 inches diameter, 22 feet long, having 130 tubes of 3 inches diameter and 15 feet long. There is also an air pump condenser, 6 × 10 × 12 in., and one duplex feeder pump with cylinders 5 1/4 × 3 1/2 × 6 in. stroke.

Two spuds for holding the dredge in position and feeding it ahead are located at the stern of the dredge. These spuds are of oak 12 × 12 inches by 30 feet long. The contract provided that they should be operated by steam cylinders, but this was slightly altered, one hori-

zontal cylinder for feeding the dredge ahead by means of the stepping spud being constructed, and the hoisting being done by means of drums placed upon the lower deck immediately under the forward engine, and worked by a sprocket chain and two steel cables carried over the deck house to the stern of the dredge. The machinery, with the exception of the boiler, was constructed by the Skinner Engine Company, of Erie, Pa. The dredge was christened the "Daniel Lamb," after the chairman of the Board of Works for 1895, through whose efforts the appropriation for the work was made.

LONG-DISTANCE TRANSMISSION OF ELECTRICITY IN CANADA.

BUT a brief space of time has elapsed since it was considered impracticable to transmit electric power beyond the immediate surroundings of the generating station. There were to be found, at that time, persons who predicted that the transmission of electricity to any considerable distance would never be successfully accomplished, owing to the many difficulties to be overcome, such as loss of current, dangers of transmitting current at high voltage, etc. The developments of the last few years, however, have served to show how erroneous were these conclusions. To-day we find electricity being successfully transmitted nearly half a hundred miles. This has been rendered possible by the present high standard of efficiency of electrical apparatus, making it perfectly safe to transmit current at 20,000 volts, and reducing the loss in the line to a very low point.

It would appear that the long-distance transmission of electric power is yet in its initial stages of development. On all sides we hear of projected schemes, the promoters of which evidently feel encouraged by the success of late undertakings in this direction. Many of the valuable water powers in Canada promise to be utilized at an early date to supply light and power to adjacent cities, towns and villages.

The longest electrical power transmission yet undertaken in America is that of the Southern California Power Company, which purposes to deliver current at Los Angeles and Pasadena, a distance of eighty miles from the water power and generating station. The electrical machinery for this scheme is now being installed by the General Electric Company. The second longest transmission line is at Salt Lake City, the distance being thirty-six miles.

Coming nearer home, we find the water power of the Niagara Falls being utilized to supply power to the city of Buffalo, a distance of twenty-two miles. Then in Canada we have the transmission plant at Three Rivers, Que., a description of which appeared in the *ELECTRICAL NEWS* for October, and a less pretentious scheme at Trenton, Ont., both in successful operation. In British Columbia the West Kootenay Power and Light Company are developing the water power of the falls of the Kootenay river, the Canadian General Electric Company now being engaged in installing the electrical machinery. It is intended to develop 2,000 horse power immediately, the ultimate scope of the undertaking being to utilize the full power of the river, estimated at 10,000 h. p. The current will be carried, at 20,000 volts, to a substation at Rossland, where it will be reduced to 2,000 volts and delivered to motors for use in mining operations.

The latest scheme to take definite form is that of the Cataract Power Company, of Hamilton, Ont. This company, of which Hon. J. M. Gibson is president, was incorporated in the summer of 1896, having for its object the transmission of electric power from DeCew Falls to Hamilton, a distance of thirty-two miles. The matured plans of the company, however, show that the original intention of utilizing these falls has been abandoned. The power will be transmitted from a point near St. Catharines. The water power to be used is the overflow from the Welland Canal, which is led to the Niagara escarpment, where it will have a fall of about 260 feet. The length of the transmission line will be a little more than thirty miles.

The contract for the electrical machinery and line construction for this extensive undertaking was awarded a fortnight ago to the Royal Electric Company, of Montreal. This is among the largest contracts of the kind ever given in Canada, the price of dynamos alone being in the vicinity of \$200,000. The turbines will be supplied by the Stillwell, Bierce & Smith Vale Company, of Dayton, Ohio.

The scheme includes the construction of a canal from Allanburg to the cliffs at DeCew Falls, at the foot of which the power house will be built. This canal will be four and one-half miles in length, and from 40 to 45 feet wide, and will tap the Welland canal at Allanburg. The contract for the canal has been given to Angus McDonald & Company, who have already commenced work.

The initial installation will be for 3,000 horse power, but the plant will be designed for an ultimate capacity largely in excess of this amount. The current will be transmitted at 20,000 volts, the danger to operators in transmitting under this pressure being removed by a specially constructed switchboard.

The company have appointed Mr. H. R. Leyden, late of the Royal Electric Company, as manager. Mr. Leyden's experience in work of this character gives special fitness to his appointment to this position. It is expected that the enterprise will be completed early next spring, when the company will be in a position to supply light and power to the city of Hamilton. The entire work, including machinery, canal and distribution line, will, it is estimated, cost in the vicinity of half a million dollars, and must be regarded as a gratifying evidence of Canadian enterprise.

A full description of the engineering features of this important plant will be furnished in a future number of this journal.

The Perth Waterworks Company, Limited, which is installing the waterworks system for Perth, will use electric power for pumping. Their pump-house is located within the limits of the town of Perth, but the power which they intend using is about four miles away, on the Tay river. Here they are installing a water wheel and a 200 h.p. generator, which will, in addition to supplying the power for pumping purposes, furnish light and power for the town of Perth. The Waterworks Company has bought out the old Tay Electric Company, and will distribute light and power on their old circuits. The electrical machinery is being installed by the Royal Electric Company, who will use their S.K. C. two-phase system for this work. The pumping is to be done by means of a 75 h.p. motor belted directly to a triplex double-acting power pump, which pumps directly into the mains, no gravity system or stand-pipe being employed. The mains are equipped with a relief valve, so that the pressure can be maintained constant without varying the speed of the pump. The pump is arranged so as to be operated at two different speeds, in order to raise the supply of water and the pressure for fire purposes.

MR. D. H. KEELEY.

THE late F. N. Gisborne, who died in August, 1892, was succeeded as general superintendent of the Dominion Government Telegraph Service by Mr. D. H. Keeley, a portrait of whom appears on this page. Mr. Keeley was ably qualified for the position by his past experience in telegraph work, and since assuming his duties has given the utmost satisfaction to the department.

The subject of our sketch has been prominently connected with the Canadian Electrical Association, having contributed valuable papers thereto. He is a member of the Council and of the Medal Award Committee of the Canadian Society of Civil Engineers, in which office he may be said to stand as the representative of the electrical engineers' branch of the Society. He is also a member of the British Institute of Electrical Engineers.

THE ELECTRICAL NEWS of March, 1895, contained an interesting article entitled "Our Government Telegraphs—Their Scope and Special Functions," which showed the extent of the government telegraph system and the territory served. At that time there were 2,451 miles of land lines and 206 miles of submarine cable,



MR. D. H. KEELEY.

with a total of 148 offices. These were distributed from British Columbia to Newfoundland. It will thus be seen how arduous and important are Mr. Keeley's duties, which continue to increase each year. In 1893 there were transmitted over government telegraph lines 41,550 messages. The expenditure upon the service was \$49,000, and the revenue collected amounted to a little over \$9,000.

The steamship "Newfield" is provided with the necessary appliances for picking up and relaying cables, and is made available for the work in the gulf when needed. The electrical work has been for years superintended by Mr. Keeley. When a break-down occurs in a cable electrical tests have usually to be made to determine the location of the trouble.

CANADIAN AGENT WANTED.

A LARGE European manufacturer of electrical machinery is desirous of securing a good Canadian representative, with a view of extending their business in this country. Any person wishing to act as such may obtain the name and address of the company at this office.

The management of the Montreal Cotton Mills Company at Valleyfield, Que., contemplates substituting electricity for coal to dry the cotton.

NEW PLANT FOR THE METHODIST BOOK-ROOM.

THE largest printing establishment probably in Canada is that owned by the Methodist church, and known as the Methodist Book & Publishing House, situated on Richmond street west, Toronto, and having a frontage also on Temperance street. The Richmond street building has 100 feet frontage and is four storeys high, exclusive of basement. Here is situated the retail department, editors' and others offices, board room, etc. The Temperance street front extends over 118 feet, on which is a six storey building, with basement, containing engine and boiler rooms, shipping offices, wholesale book departments, binding, folding and stereotyping rooms. Connected with these front buildings is another, consisting of four storeys, in which is contained the press room, composing room, book stock room, general office and store room.

The buildings are heated entirely by steam, the mechanical department by exhaust from the engines, and the front buildings, offices, etc., by the low pressure gravity system. The boiler and engine rooms of an establishment of this extent are necessarily large and attractive. In the boiler room are two 60 horse power boilers made interchangeable for high and low pressure. These are fed by a Northey steam pump. In the engine room are the engines, two Wheelocks, 60 and 90 h. p., connected to an underground shaft by large belts and arranged with friction clutch pulleys so that either engines or both may be used at any one time.

A new electric light plant has recently been installed for lighting the building, the electricity being generated by a $10\frac{1}{2} \times 10$ Ideal engine, direct connected to a 50 k. w. dynamo, manufactured by the Toronto Electric Motor Company, the engine and dynamo only occupying a space 6 by 8 feet. Current is generated for 650 incandescent lamps of 16 c. p. each, and from the machine there can be run as well, through motors, arc or incandescent lights. The armature of the generator is of the wave-wound type, with ventilated core, and so constructed that no wire passes over the ends. Consequently no dust or dirt is allowed to accumulate. The crown is of heavy iron, with the laminated poles cast in so that the magnetic current is perfect. Beside the generator stands a marble switch-board, with instruments complete, the whole making an up-to-date and efficient plant. The establishment is protected against fire by two large stand-pipes running from cellar to roof, with hose on each flat attached and ready for use.

Mr. G. C. Mooring has entire charge of the steam plant and machinery, having been employed by the firm for over eight years. He is popular with his brother engineers, and was a charter member of Toronto No. 1, C. A. S. E., of which association he is now president.

Mr. Wm. T. Bonner, formerly general agent for Canada for the Babcock & Wilcox Company, has recently returned from a trip abroad, and will take up his residence in Montreal again, as manager for Canada for Babcock & Wilcox, Limited, of London and Glasgow. Temporary quarters have been taken in the Board of Trade Building, but as soon as the decorators and furnishers can complete their work, the Babcock & Wilcox offices will be located in the Mechanics' Institute building, at the corner of St. James and St. Peter streets. A full line of samples and models of the Babcock & Wilcox water tube boilers and accessories will be exhibited, and every facility and convenience placed at the disposition of the engineers and steam-users, to give them a thorough understanding of the merits of the Babcock & Wilcox Company's goods.

DISCOVERIES OF MICHAEL FARADAY.

SOME interesting particulars of the life of Michael Faraday, the great electrical discoverer, are furnished by the American Electrician, to whom we are also indebted for the accompanying portrait.

Michael Faraday, born 1791, died 1867, the son of a poor mechanic, was, at the age of thirteen years, apprenticed to a bookseller. He worked for some years as a bookbinder, afterwards securing a position with Sir Humphrey Davy in the Royal Institution, where his great career was commenced. A diligent student, and always seeking information, he attended lectures on natural philosophy and other subjects, which created a strong desire in him to engage in scientific work. He was first appointed laboratory assistant in 1813, and his first discoveries were made seven years later.

In 1821, Woolaston conducted some experiments in the laboratory of the Royal Institution to realize an idea he had formed from Ampere's discoveries, that a conductor carrying a current could be made to rotate about the pole of a magnet and vice versa. In this he was unsuccessful, but Faraday, taking up the subject, finally succeeded in obtaining such rotation. The apparatus thus constructed by Faraday was the first electric motor; ten years later he constructed the first transformer and also the first dynamo—the Faraday disk.

In the period between 1821 and 1831, among other discoveries made in chemistry by Faraday was that of the element chlorine. He became director of the Royal Institution laboratory, and in 1831 made his great discovery of electro-magnetic induction, which turned his mind definitely toward pure science as the sole object of his life, and thenceforth he permitted nothing to distract his attention from it. On August 29 of the same year he succeeded in making the greatest discovery of all time and laying the foundation upon which rests the great electrical development of the past 25 years. It was that electricity was capable of being produced by magnetism. The apparatus used consisted of an iron ring wound with two coils of bare wire, one about 72 feet and the other 60 feet long, the turns being separated by twine and the layers by calico. The longer coil was connected to a primary battery, and a loop of the other passed over a magnetic needle. When the battery circuit was made or broken, the needle was deflected one way or the other, by the induced current set up. This apparatus was the first transformer, combining every principle of the modern apparatus known by that name.

These discoveries followed: September 24, that a current was induced in wire coiled on an iron cylinder when a magnet was approached to the latter; Oct. 1, that if a current passed through one of two adjacent coils on a block of wood was made or broken, a momentary current flowed in the closed circuit of the other

coil; Oct. 17, that current could be generated in a coil by merely inserting and removing a magnet.

On October 28th Faraday made the first dynamo by revolving a disk between the poles of a magnet; when one end of the wire of a closed circuit was pressed against the circumference of the disk and the other against its axis, a continuous current was produced.

On the final day of his great experiments, he found that by merely passing one side of a closed circuit between the poles of a magnet, a momentary current was induced in it. To explain all of the various phenomena observed, he conceived the idea of lines of magnetic force proceeding from a magnet, or surrounding a conductor carrying current; that when a conductor cuts such lines an E. M. F. is generated in it; and that the amount of this E. M. F. is proportional to the number of lines cut in a given time.

It should here be remarked that Henry in August of 1831, independently discovered electromagnetic induction, his experiment being very similar to the first successful experiment of Faraday. He did not, however, follow it up.

Two other epoch-making discoveries are associated with Faraday's name—the laws of chemical decomposition and the magnetic rotation of the plane of polarization of light.

After a magnificent series of experiments he laid down the law known as Faraday's law, which formulates the relation between the strength of current and amount of any substance deposited by it. He also found that if a ray of light was passed through certain media, and if these media were placed in a field of force, the plane of polarization was changed, being rotated through a definite angle for each substance and each strength of

field. This principle has recently been used by Crehore and Squier in the construction of a chronoscope and in a system of rapid telegraphy. This is only some of the discoveries made by Faraday.

It is expected that there will be keen competition between Canadian and United States firms for supplying the equipment of the proposed electric railway at Kingston, Jamaica. Messrs. Wm. McKenzie and James Ross are the chief promoters of this scheme.

A contract was concluded a couple of months ago between the Southern California Power Company and the General Electric Company for the transmission of the power of the river running through the Santa Ana Canyon to Los Angeles and Pasadena, Cal., a distance of 80 miles. The amount of power to be transmitted at first is 4,000 horse power. The station will be located in the Santa Ana Canyon, 12 miles from Redlands and about 80 miles from the towns in which the electric power will be utilized. The water will be taken from the river to canal, flume and tunnel along the side of the canyon. Here it will be led into a pipe line 2,200 feet long, giving what will be equivalent to a vertical fall of 750 feet. This transmission will be the longest electrical power transmission yet undertaken. At present the longest is at Salt Lake City, where power is transmitted a distance of 36 miles.



MICHAEL FARADAY.

MUNICIPAL LIGHTING PLANT.

THE town of Orillia, Ont., operates its electric system in connection with the waterworks plant. The management of the plant is vested in a board selected from the town council, Mr. J. S. Millan being chairman. Mr. P. Ritchie is engineer-in-charge, and under him are three assistants.

The plant is situated near the lake, where condensing water is easily obtainable. The G. T. R. tracks pass alongside the power house, by which means the fuel supply is easily obtained. Nature supplies an abundance of pure spring water into a partly submerged tank, with a capacity of 33,000 gallons. These springs are situated on Muskoka Hill, an elevation in the northern part of the town, and the water gravitates to the tank.

Besides this tank there is a stand-pipe three-quarters of a mile away, with from 100 to 120 pounds pressure. There is also a reservoir on Peter street with a capacity of 250,000 gallons.

Forty-five arc lamps light the streets, and 2,300 incandescent lamps are installed for public and private lighting.

The power house is a substantial brick structure, divided into two compartments—one for engines, dynamos, etc., the other for the boilers and pumps. The dynamo room is 35 x 40 ft., and presents a neat appearance. Two Goldie & McCulloch 100 h.p. cut-off condensing engines, harnessed to a line of shafting which extends across one end of the room, operate the machines. Four clutches by the same makers are on the shafting, so that one or all the machines may be worked together, or separately. These machines are two 1,000 k.w. Thomson-Houston alternators, and three Ball arc machines of 25 lamps each, each lamp being of 2,000 c.p.

In the centre is the large steam pump built by McQuillan & Co., of Toronto, capable of pumping 900 gallons of water per hour and throwing 19 gallons per stroke, with 50 strokes to the minute. A spare pump, of Northey make, with a capacity of 200 gallons per minute, is kept in case of emergency. A Goldie & McCulloch condenser in the basement, fed by a Northey pump, condenses for the engines.

The steam main from the boilers is six inches in diameter, with five-inch feeds to the engines and four-inch to the pumps.

At the end opposite the shafting is a large C. G. E. skeleton switchboard, fully equipped, placed half-way up the wall, and reached by iron stairs leading to an iron platform surrounded by brass railings. This is claimed to be a great improvement over the usual manner of arranging switchboards, as the operator is right over his work and has view of all the machines, engines and pumps.

The ceiling of the building is of matched lumber and nicely painted, setting off the bright dynamo room. The boiler room is smaller than the dynamo room, but there is space left for an increase of plant. Two boilers fed by a double-plunger pump and a steam pump generate steam for the two engines. The plunger pump is operated by a belt from one of the engines on the dynamo.

One boiler of 100 h.p. is made by Goldie & McCulloch Co., the other by Perkins & Co., of Toronto.

The plant, as a whole, is very creditable, and few better are found in Ontario.

CORRESPONDENCE

THE PROPOSED STEAM BOILERS ACT.

DARTMOUTH, NOVA SCOTIA, Oct. 11th, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR, —In reading the bill called "The Steam Boilers Act," as it appeared in your issue of June, that was put before the Dominion parliament last session, by the Canadian and Ontario Associations of Stationary Engineers, it appeared to me that the fifth clause or section as it reads, seriously impairs the usefulness of the whole Bill from an engineer's standpoint.

For the benefit of those who may not have read the Bill I will, with your permission, quote the above-mentioned clause :

"Every person who, at date of the passing of this act, has been for two years engaged in the operation of steam boilers, upon producing a certificate of his uniform good conduct and sobriety from the owners by whom he has been employed during the said period, and also from some responsible person not connected with the business of such owners and a resident in the municipality or in each of the municipalities in which such boilers have been so operated, or a holder of a certificate from any incorporated body or from any province, shall be entitled, upon making an application to the chairman of the board on or before the first day of January, 189 , and upon payment of dollars to the chairman, to receive a certificate of qualification and to be registered under the provisions of this act."

Now the fact that a man has had two years experience in charge of a steam plant is certainly no guarantee that he is qualified to operate steam boilers and engines safely and with intelligence, even though his character may be the best, and the fact of his obtaining a certificate without an examination won't make him so. I can call to mind men who have been feeding fuel to the furnace and twisting the throttle valve and squirting oil for years, but if you were to ask them what is the safe working pressures of their boilers, or the tensile strength of the plate therein, they would look at you in astonishment—they never heard of such a thing. Will it be fair to honest and studious engineers to grant such men certificates? Will it be fair to the public? If I understand the said clause correctly it will not.

Brother engineers, let us have an act that will be a credit as well as a benefit to ourselves—an act that will be a guarantee to the public that the men who are in charge of such terrible agents of destruction (when carelessly and ignorantly handled) are men who have been duly examined and have been found well fit to fill the positions they hold.

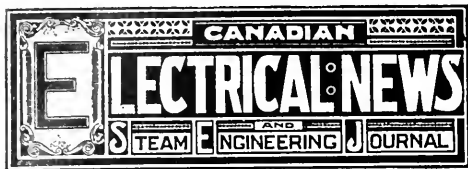
Under a proper license law, every man, no matter how many years of experience he has had, should undergo an examination and receive a certificate according to his fitness, if he be entitled to one. Also, what size plant a man holding a certain class certificate will be allowed to operate, should be clearly stated.

We all know, once an act becomes law, what a job it is to have it amended. I hope we will hear from other engineers on the subject. Thanking you for space, I remain

Yours truly,

ACADIAN ENGINEER.

The Strathroy Electric Light Company, Limited, are adding an incandescent lighting equipment to their new are lighting plant and have placed their order with the Canadian General Electric Company for a 30 kilowatt standard single phase alternator of the company's latest type.



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Apparatus for Improving Electrical Supply.

In the continent of Europe and in the United States engineers are devoting their energies towards the improving of electrical supply, not only for lighting, but also for power, heating, electrolytic and railway services, and the last two years have seen great changes, and great progress in the methods of central station operation and in the general economies of electric lighting and power. In Germany, where some of the best and most prosperous electrical central stations are to be found, they use storage batteries in connection with nearly every generating plant, and in Great Britain they have evolved and taken rapid hold of two very important improvements, viz., the 220 volt lamp and the alternating current rectifier for arc circuits. Is there a rectifier in the whole of Canada? Is there one individual central station in the Dominion that has manifested sufficient regard for its own interests as to investigate the merits of a storage battery auxiliary? Has anyone ever asked for a 220 volt lamp? The matter rests with the public. Let them insist on improved, up-to-date apparatus, and be willing to pay reasonable prices for it, and the manufacturing companies will meet the demand.

Method of Charging For Current.

A MATTER that is receiving the attention of wide awake managers in Great Britain, and is even spreading to America, is the method of charging for current. It seems open to question whether a meter rate is always the best way. There seems to be a limit of population below which a "flat rate," while theoretically imperfect, is commercially the better way, and above this limit the flat rate can be applied in certain cases where the rate of current consumption is regular and the hours certain, while meter rate is applied to the customers. But even then it can be reasonably argued that there should be graduations in the meter charges, corresponding to the duration of the time during which current is supplied. Assume for purposes of illustration a 1000 light plant, with current supplied by meter, and take two consumers; the first burns thirty 60 watt lamps for 10 hours, consuming 18,000 watt hours, the second burns one hundred 60 watt lamps for three hours, also consuming 18,000 watt hours. While their consumption has been the same and they pay the same, still it is evident that the central station has to keep one-tenth of the capacity of the machine for the second consumer, but only one-thirtieth for the other. It is plain, therefore, that the first consumer is the more profitable, and others like him should be encouraged. In the smaller plants, however, it is at least open to question whether the expense of purchase and up-keep of meters would repay their

use. No doubt the business done could thereby be extended somewhat, but the continual testing of meters and questioning of their accuracy would impose a burden hard to be borne.

The Paris Exposition.

The great exposition that is to take place in Paris, France, in 1900, should not be lost sight of by Canadians, and by Canadian manufacturers in particular. The time is distant a little less than three years, and it is now none too early to begin preparations for making a creditable display of Canadian products and manufactures. We are pleased to observe that a deputation from Montreal has drawn the attention of the Dominion government to the matter, and that there is a strong probability of assistance being received from this source. But in addition to a Dominion grant, it would seem fitting that each provincial government should assist to secure the advantages which are certain to accrue to us from a commercial standpoint by having Canada properly represented at this exposition. This year the Dominion of Canada has been advertised abroad as never before, and the benefits therefrom have already commenced to be realized, as shown by enquiries received by manufacturers. Having thus made a start we should seize every opportunity to further extend our trade relations, and where a foothold is once secured the quality of our manufactures may be relied on to keep the market.

Municipal Control of Electric Lighting.

The ratepayers of the city of Toronto will shortly be called upon to decide one of the most important questions ever submitted to a popular vote. They will be asked to declare themselves for or against the municipal control of electric lighting. The subject is receiving much attention from the public press, and, as is usual with questions of this character, widely varying opinions are expressed. The *Globe*, in a leader in its issue of November 5th, states that according to statistics over two hundred American cities have experimented with public electric lighting plants, and follows this with some figures showing the cost per lamp per annum in several of the cities where municipal control obtains. The figures as given, unaccompanied by any particulars of the conditions surrounding the operation of the plants, are evidently intended as an argument in favor of municipal control. But only one side of the case is presented. Of the two hundred cities that have thus experimented, no information is given regarding the plants that have proven an entire failure under municipal management, but half a dozen or more plants are selected which evidently suited the requirements of the article. The city of Detroit is pointed to as having greatly reduced the cost of its lighting by installing a public plant. A fair comparison may be made between the cities of Detroit and Toronto, the population being about equal. We have in our possession the annual report of the Detroit municipal lighting plant for the year ending June 30th, 1897. This statement shows that the city operates 1,600 arc lamps of 2,000 c. p. each, and that the actual cash outlay last year was \$64.19 per lamp, exclusive of depreciation of plant, interest on outlay, or taxes which would otherwise be paid to the city. Allowing for these, the report gives the total cost per lamp as \$89.42, as compared with \$87.40 the previous year. But in the item of depreciation only the boilers are taken into consideration, on the ground that as the balance of the

plant was kept in the best possible condition of repair, the cost of depreciation would be too small to be worthy of consideration. That this is an unfair comparison every reasonable person will admit. Careful attention may prolong the life of the machinery, but it cannot prevent it from ultimately wearing out. Furthermore, no allowance is made in the report for insurance. Placing the depreciation and insurance at the very lowest estimate of 3 per cent., the cost per lamp per annum would be \$97.26. Let us see how these conditions compare with those in Toronto. We are supplied with about 1,200 arc lamps of same capacity as those in Detroit at \$74 per lamp per year, a difference of \$15 as compared with the cost of lighting in Detroit as given in the report, and of \$23 if depreciation and insurance are taken into account. Then there is the fact that the cost of fuel and supplies is less in Detroit than in Toronto, a very important consideration. It has been pointed out that Detroit is now producing its light at a lower cost than that paid by private contract previous to the installation of the plant. This is not due to the economy of a civic plant, but rather to improved machinery, cheaper supplies and other considerations. As proof of this stands the fact that the cost of electric light to the city of Toronto by contract has also been greatly reduced within the last few years. Now, as to the first cost of an electric plant of sufficient capacity for the present requirements of Toronto, the figures given in the Detroit report show an investment of nearly three-quarters of a million dollars, and that each arc lamp cost \$337.88. These are considerations which should be carefully weighed by the ratepayers. They will do well to be guided by the results of experience rather than by theory.

Extraction of Ore By Electricity.

THE mining world has been watching with much interest the success of the experiments by Mr. Edison to recover by an electrical process the iron contained in low grade ores. It has long been known that by means of magnetism the extraction of iron ore could be accomplished, but the problem to be solved was the perfecting of a process which would render the treatment of even the leanest deposits commercially feasible. To this end Mr. Edison has in a measure concentrated his efforts, and it would now seem that after a large expenditure of money he is to be rewarded by success. His experiments have been carried on in New Jersey, where about \$3,000,000 has been expended in plant. The process by which iron mining promises to be revolutionized consists in applying the principle of the magnet, by which the little black particles of ore are drawn from the pulverized rock. The powder is allowed to fall in close proximity to electric magnets, which deflect the iron to one side and the non-metallic matter falls to the other side by gravity, the entire process being automatic. This is one of the greatest of Mr. Edison's many achievements, and one which will undoubtedly have a far reaching effect upon the iron industry throughout the world. To Canada it is likely to prove of great benefit. We have abundance of iron ore deposits, but the difficulty in the past has resulted from the absence of cheap coal in close proximity to the mines. Thus the advantages of the application of electricity for ore extraction is at once apparent. That he has finally reached the goal of success must be a source of gratification to all persons as well as to Mr. Edison.

LIGHT, A BRANCH OF ELECTRICITY.

By C. A. CHANT, B.A.

THE most distinguishing feature of the science of our age has been the establishing of comprehensive general principles as results from closely-reasoned processes of induction. Any branch of science is chosen, and after analyzing its almost countless phenomena in order to discover as well as possible their true nature, the reverse process is taken, objects with analogous properties are classed together, these classes are again co-ordinated, until at last we reach a grand unity, held together by a single broad principle.

Illustrations will at once suggest themselves. In biology we have the great principle of evolution. Many gaps, no doubt still exist in a complete statement of it, but the general theory itself is so based on hard experimental fact, that it must be true in its general outline at least. In chemistry, although the non-predictable nature of many of its combinations gives to it a certain arbitrary or empirical aspect, has as its fundamental ground-work the principle of the conservation of matter, that is, matter cannot be created or destroyed, but only transformed from one shape to another. From the time that this was first solidly established a little over a hundred years ago, the science has continued to grow in a healthy way. Of late it has become somewhat more physical in nature, due to its employment of physical methods and working on the border line between physics and chemistry. In physics we have the grand principle of the conservation of energy, a fitting complement to the base-principle of chemistry.

These are probably the greatest illustrations of the statement I have made, but there is another, not quite so wide in its nature, of which I wish to speak, namely, of the intimate relation between radiant heat, light and electricity which has been triumphantly demonstrated in very recent years, and which is usually known as the electro-magnetic theory of light.

Since this theory has come into prominence so lately, many are inclined, on learning of it, to think of it as a purely recent production. But such is not the case. No great scientific principle ever sprang from the mind of man full-grown. As a matter of fact, the seeds of the theory were sown more than half a century ago by that prince of experimental philosophers, Michael Faraday; the plant was cultivated and brought into bloom

by Clerk Maxwell as much as thirty years ago; while, led by Hertz, the world has plucked the ready fruit during the last decade. A discovery may be flashed over the world in a day, for instance, the Roentgen X rays; but almost two years have passed and we have scarcely begun to learn their inner nature by which alone we can rationally classify them.

I shall attempt to explain in a few words how light has come to be regarded as included in electricity.

We are all familiar with the old experiment of rubbing sealing wax on a woollen coat-sleeve and then picking up bits of paper. By rubbing we are said to charge the wax with electricity. Electrical machines, with glass plates, are more efficient in producing a similar effect. Suppose we suspend two metal balls by means of silk thread (Fig 1), and then charge each of these by means of an electrical machine. It has been

found that there is then a force exerted between A and B, variable with the distance between them. In this case they mutually repel each other. This fact was an old, old one; but Faraday conceived that the action of A on B must have something to do with the space between them.

To test this, he filled the space between the two attracting or repelling bodies with various substances, such as paraffine, petroleum, etc.; and, just as he suspected, the mutual action was thereby much altered. He therefore concluded that this "electric force" was handed on from one body to the other by means of something between them. But this force is exerted even in a vacuum, and so the handing-on medium must be quite distinct from ordinary matter.

In a similar way let us consider two magnets (Fig. 2)

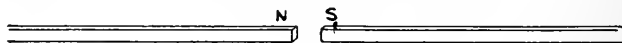


FIG. 2.

with two poles N and S, near together, but so long that the other poles may be neglected in our reasoning. There is an attraction between N and S. If we immerse them in water, or oil, the change in this attraction is so slight that we cannot detect it. But if we could surround the magnets in an atmosphere of iron, this force would be very greatly diminished. As before, the action depends on what is between the two poles, and so magnetic force is also to be considered as being handed on from one body to the other by means of something in the space between.

But if a body transmits through its mass a motion given at one point, time is required to do it. For instance, sound takes time to pass through the air, water, iron, or any other substance. The question is naturally suggested, With what speed are the electric and magnetic forces transmitted from one body to another? Faraday tried to measure this for magnetic force. Indeed, Lord Kelvin tells us that the very last time he saw him at work in the Royal Institution he was down in the basement, far from disturbance, endeavoring to determine the time required for the magnetic action to travel from an electro-magnet to a magnetized needle many yards away; but the attempt failed, no time was observed.

Maxwell followed, and on applying his great mathematical ability, he succeeded in deducing a theoretical value for this speed, and this value when calculated turned out to be extraordinarily near the velocity of light—so near, indeed, that he was led to believe they were really identical.

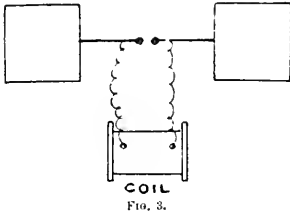
Now, for many years the wave theory of light has been accepted as true, and this theory requires us to believe that light action is handed on from one point to another by a medium pervading all space, known as the ether. At once we grasp at the suggestion that this ether is the very medium required for the transmission of electrical and magnetic effects, and when Maxwell found that the speed of transmission in each case is the same—that of the velocity of light, 186,000 miles per second—he considered this suggestion practically demonstrated to be true. He then propounded the theory that the disturbance known to us as light is really electro-magnetic in its nature. Very recently the actual velocity of the transmission of electric and magnetic actions has been measured, the same as the velocity of light. If, then, light is an electro-magnetic



FIG. 1.

phenomenon, optics must be but a branch of the imperial science of electricity.

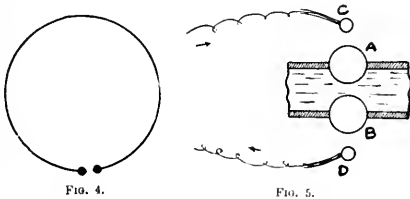
Again, energy, in the form of light, is transmitted in the ether by means of undulations or waves; electrical energy should likewise be transmitted through the same ether in waves. We are well acquainted with methods of generating and of detecting light waves; how can we generate and then detect electric waves? Hertz answered this question. One of his radiators, or generators of electrical waves, is illustrated in Fig. 3.



It consists of two sheets of metal from which run out rods ending in knobs near together. If, now, this be joined to an induction coil, and the coil be put in action, sparks will pass between the knobs, and every time a spark passes, the ether about the metal will be agitated, and the disturbance thus caused will spread in every direction, just as light radiates from a candle.

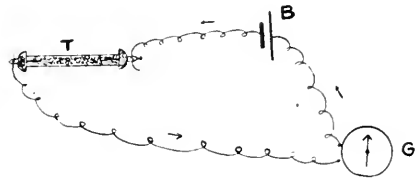
But how shall we detect these waves? The eye, which is so marvellously sensitive to light waves, is entirely unaffected by these longer ones. But Hertz discovered that by taking a wire with a knob on each end and bending it round as in Fig. 4, he could use this for his purpose. Holding it almost anywhere near the radiator, small sparks would pass between the knobs, caused by the electric energy transmitted to it. By suitable arrangements sparks could be seen more than twelve yards away. By means of such radiators and receivers (or detectors), Hertz investigated the nature of the electric radiation, and found that it was in waves which, he showed, possess all the ordinary properties of light, i. e., they both follow the same physical laws.

Since these researches (1887-1890) radiators and re-



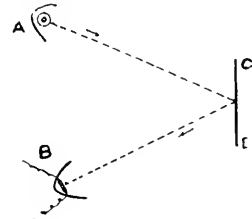
ceivers of many different forms have been devised to more easily illustrate the discovery of Hertz. A very convenient form of radiator, due to Righi, Professor of Physics in the University of Bologna, is illustrated in Fig. 5. A and B are two metal spheres fitting tightly in the centres of two ebonite discs which form the top and bottom of a cylinder with flexible walls. This cylinder is filled with vaseline oil, so that half of each ball is in the oil. The knobs C and D are connected to the coil, which, when excited, causes sparks to pass from C to A and D to B, and then from A to B through the oil. By this means electric waves are sent out in every direction. If the cylinder be placed in a parabolic reflector (of sheet metal) the radiation may be projected forward in a single direction, like that from a locomotive headlight.

One of the most convenient receivers is what Lodge has termed a "coherer." It consists simply of a glass tube nearly filled with metallic turnings or filings (Fig. 6.) When this is placed in the path of electric waves,



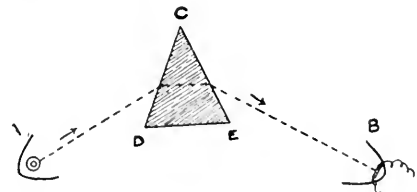
the bits of metal seem to cohere, so that an electric current can pass through them more freely. The arrangement to show this is given in Fig. 6. T is the tube, and pieces of wire run into each end and terminate amongst the turnings. B is a voltaic battery, and G is a galvanometer for measuring the electric current. These are joined as in the figure. Usually the resistance of T is so great that no appreciable current flows and the galvanometer is undeflected, but as soon as the electric waves get amongst these turnings they "cohere," the resistance falls, a current passes, and round goes the needle! By simply tapping the tube the coherence disappears and all is ready for another trial. This tube may also be enclosed in a parabolic reflector, and thus made more sensitive in certain directions. Using these instruments the various laws of optics can be verified for electric waves.

To show reflexion, let us arrange the radiation and receiver as A, B in Fig. 7. The radiation goes out



from A in the direction indicated by the arrow, and if a metal sheet (tin foil on a board will do) be held at C D the beam is reflected toward B and will be indicated on the galvanometer.

Refraction is very interesting. To show this we place the radiator and receiver as shown in Fig. 8. The receiver is little affected on working the radiator; but on putting a prism of some good non-conductor, such as paraffine or pitch, at C D E, the galvanometer at



once registers a strong action. The radiation is bent from its original direction by the prism C D E. Hertz's original experiment is a famous one. His radiator and receiver were of great size, and the section of the prism made of hard pitch was an isosceles triangle, having a

side of nearly four feet and refracting angle, C, of 30 degrees. The height of the prism was nearly five feet, and it weighed over 1,300 pounds.

Experiments on total reflexion, double refraction, polarization, and other well-known optical effects have been successfully made, thus completely identifying electric and light waves.

Great interest has been shown during the last year or two in the experiments made by Preece and Marconi on signalling without wires. The former is chief of the British Postal Telegraph, and the latter is a young Italian who showed some of his apparatus to Preece and secured his co-operation in the experiments. The method used by these men is precisely that described above—by means of electric waves.

A general diagram of the apparatus is given in Fig. 9, the upper part showing the transmitting, the lower part the receiving apparatus. The radiator is the same as that illustrated in Fig. 5. Its two spheres, A, B, are of solid brass, four inches in diameter, each projecting into an enclosure filled with oil. The induction coil, shown in Fig. 9, which produces the spark discharge between the spheres and thus excites the electric waves,

is a very powerful one, capable of giving a twenty-inch spark. K is a key for starting and stopping the coil.

Marconi's receiver is a slight modification of that in Fig. 6. It consists of a small glass tube $1\frac{3}{4}$ inches long, into which two silver polepieces are tightly fitted, the ends being about 1-50th of an inch apart. This narrow space between the ends is filled with a mixture of nickel and silver filings mixed with a trace of mercury. The tube is then pretty well exhausted of air and sealed up. Thus constructed the receiver is very sensitive. From each end of the tube extends metallic wings, W, W, which assist in collecting the radiation, in 'tuning' the receiver to the radiator, and perhaps in other ways not yet explained.

In place of the galvanometer in Fig. 6, is put a sensitive telegraph relay, which "clicks" when the waves reach the receiver tube. To "decohere" the

particles in the tube and make it ready for a second signal, the current which works the sounder is also arranged to work a small hammer (shown in Fig. 9), which taps the tube and produces the desired effect.

For short distances, where nothing obstructs the passage of the waves to the receiver, no great difficulty is experienced in transmitting signals; but when the space to be traversed is great some new arrangement is required. Sometimes the radiator or receiver is raised

to a sufficient height, or the expedient exhibited in Fig. 10 is adopted. Here the wing W, W are removed and an aluminum wire runs up from the receiver to the kite. This wire has the power of 'picking up' the waves and sending on the disturbance to the receiving tube, and thus producing the signal.

Using these two instruments, excellent signals have been transmitted between Penarth and Brean Down,

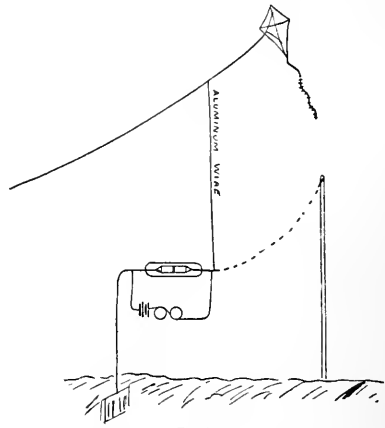


FIG. 10.

near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles.

Marconi found that his receiver responded even when enclosed in a perfectly tight metallic box, and this fact has given rise to the rumor that he could blow up an ironclad. The difficulty which might be experienced in putting such an apparatus into the powder magazine of an enemy's ship seems to have been entirely ignored.—Methodist Magazine and Review.

ONTARIO LIGHTING PLANTS.

MARKHAM ELECTRIC LIGHT PLANT.

This plant, owned by Mr. W. J. Fletcher, of Alliston, was installed in July, 1896, and is managed by Mr. Wm. Trueman. The plant consists of a Royal 500 light generator, with skeleton switchboard, furnished with Royal instruments. Power is supplied by a 50 h. p. Wheelock engine and a 60 h. p. boiler. There are installed at present about 400 incandescent lights, and a contract with the town calls for thirty-one 32 c. p. street incandescent lamps.

CANNINGTON ELECTRIC LIGHT PLANT.

The lighting plant at Cannington, Ont., is owned and controlled by Messrs. Dobson & Son. It is situated in a substantial brick power house, adjoining the firm's woollen mills. Besides the arc and incandescent system, this firm have just installed a 25 h. p. Weston dynamo to furnish power to a carriage factory, printing office and bakery in the town. In addition to this dynamo the plant consists of a 750 light Fort Wayne generator and 50 light Ball arc machine, skeleton switch-board and Canadian General instruments. Power is supplied by a 45 h. p. Wheelock engine. This company have about 400 incandescent lights and 10 arc street lamps. The arc system was first installed in 1891, and the incandescent system added two years ago.

The Hamilton & Dundas Railway Co. have ordered a 200 k.w. 500-volt railway generator from the Canadian General Electric Company.

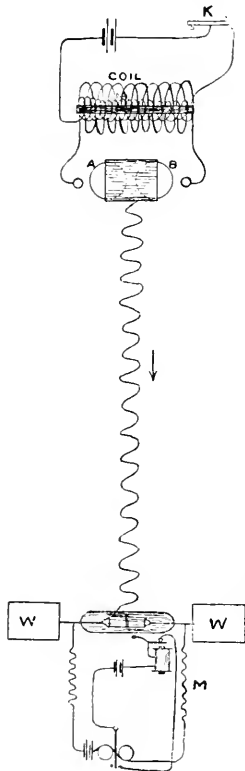
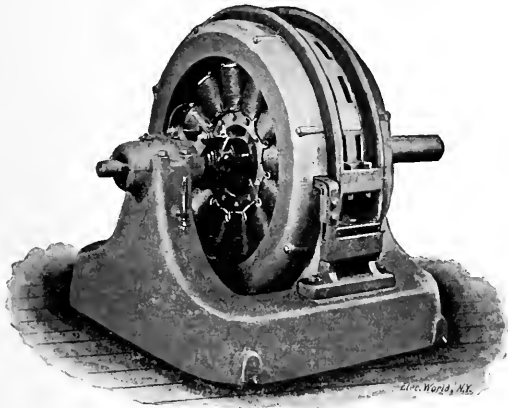


FIG. 9.

ELECTRICAL MACHINERY AT THE MERRITON CARBIDE WORKS.

THE Willson Carbide Works Company, at Merriton, Ontario, is probably the only enterprise engaged in the manufacture of carbide of calcium, which is turning out that much discussed product, daily, up to its full capacity, and at a profit. The electrical apparatus used in this plant is of the most interesting character, having been specially designed by the General Electric Company to suit the peculiar conditions under which the manufacture of carbide can be successfully carried on.

The company have at present in operation four machines of 150 kilowatts capacity each, and have recently placed an order for two more of the same size, which will be in operation in the course of a couple of months. These generators are of the revolving field type, with stationary armatures, and are designed to run continuously twenty-four hours a day, at a load considerably in excess of the rated output, without a noticeable rise in temperature. The characteristics of these machines are such as to enable them to supply a proper amount of current for a furnace at the proper voltage,



150 K.W. C.G.E. GENERATOR FOR THE MERRITON CARBIDE WORKS.

no matter what the resistance conditions of the arc may be, and they may be short circuited repeatedly or even run on a short circuit without injury. The location of two of the power houses renders necessary a transmission at 1000 volts, and in this case step-down transformers of the Niagara type are used to reduce the current to the proper voltage for supplying the furnaces.

Altogether the detail and operation of this plant is most interesting, and its success in turning out carbide of calcium on a commercial basis is in marked contrast to the operation of several plants, on a much more ambitious scale, which have been established in the United States.

DIRECT-CONNECTED ARC UNITS FOR THE LACHINE COMPANY.

THE Lachine Rapids Hydraulic & Land Company have ordered from the Canadian General Electric Company two direct-connected units for furnishing arc lighting from the citizen's station, from which they are at present supplying some 400 arc lamps, generated from steam power, with small arc machines of the "Wood" and "T-H" type. These new units will consist of synchronous motors of the three phase, revolving field and stationary armature type, each of which will be

direct connected to two 125 light "Brush" arc machines. The motors will be wound to take current at 4,000 volts, direct from the primary circuit of the Lachine company, thus saving the cost and loss in operation entailed by the use of step-down transformers. The motors will be self-starting, and are designed to operate at a very low temperature up to the rated load. The efficiency of the arc plant, operated in this way, should be very high, that of the 125 light Brush arc machine being not less than 86% to 88% at full load.

QUESTIONS AND ANSWERS.

"BACKWOODS" writes: Sir,—As there are many in the backwoods like I am, I think it would not harm us if some of our societies would send you a list of the questions brought up for explanation at their meetings, and the answers given. Kindly insert this, and oblige.

"ECONOMY" writes as follows: Please say if using a dimmer decreases the amount of current used when decreasing the light. Does the dimmer not use up the decreased light? Would a lighting company allow me to put in a dimmer between the meter and transformer?

SIR,—In answer to James McPherson: I have had the same trouble myself, and don't know yet what is the cause. I found that graphite and a little cylinder oil cured it almost entirely. I did away with the sight feed lubricator, and made two cups out of pipe fittings and globe valves, and they work fine. If a good cup sight feed for graphite could be got, it would be so much better, and I would like to know of one.

"GEORGE."

"ONTARIO" writes, in reply to Mr. Wickens, that the pumps are for ordinary water pumping; one is 200 feet from boiler and has a pressure regulator to govern its working. The drying room is common live steam coils. Referring to Mr. Thomson's reply he says: My engine, a $9\frac{1}{2}'' \times 12''$, drives one 200 ampere 125 volt dynamo, and has a load of about 50 amperes for seven hours a day. Would I gain by lowering the pressure during that period to 50 lbs.; at present we carry 80 lbs.

"SUBSCRIBER" would like to ask Mr. Thomson how it is that in the "Green Economizer" tests they can have a sufficiently good natural draft, with a temperature of 200° after it has left the economizer. Would the pipes last long, or would they be giving out all the time if put inside? Is there any real economy in using live steam to heat feed water for the boilers?

"J. G." writes, in reply to Mr. Wickens: My building is already piped, and we can make no alteration in piping. We have a steam drum in boiler room, from which nine mains rise and go up to the different floors; also a return drum, where all the water comes back into, and then into a trap.

The author of a paper presented to an English society says that in the only case of a split steam pipe within his recollection the accident was caused by the boiler water having been allowed to prime into it, producing, probably, sudden contraction. It is difficult to see how water of the same temperature as the pipe could produce contraction. Water hammer would be a better explanation.

DYNAMO TROUBLES AND HOW TO OVERCOME THEM.*

By PERCY DOMVILLE.

WITH modern uses of electricity the increase in the demand for light and power has, in many cases, proven too much for modern power stations to meet. These plants, installed ten or fifteen years ago, when the general application of electricity to purposes of illumination first became evident, have now become obsolete, or so far behind the times as to be unable to furnish a satisfactory service. These same installations under ordinary circumstances, to the uninitiated, apparently give perfectly satisfactory results, and the question is often asked by directors of companies: "Why purchase new machinery when we are filling the bill with the old? have had a few mishaps, it is true, and the power has been shut off for short times now and then, but what does it matter if we do stop for a few minutes, or even hours, if we give all that is necessary during the rest of the time." Now, the consumer of the present day, when he pays for a thing, expects to get it. So it is with the man who is depending on the electric company to light his house or to furnish power to run his shops, as the case may be. It is in nine cases out of ten that the power is shut off at a critical moment; hence it is that these companies with obsolete machinery fail to keep their consumers, many of whom feel compelled to install the more isolated plant.

With the introduction of so many of these plants, it becomes necessary for the stationary engineer of the present day who is called upon to take charge of dynamos and motors in connection with his engineering duties, not only to be thoroughly posted as to the care and running of his engine and boilers, but to be somewhat of an electrician as well. Many times he is compelled, when he takes a position, to run chances of the machinery not getting out of order, and how often is he censured for the apparatus getting out of order when the injunction has been laid against him not to meddle with any portion of the machine or its adjustments. No engineer can take charge of an engine and boiler until he has passed a thorough examination as to his fitness. Still, machinery far more delicate and liable to get out of order is forced upon him. A mischievous person with a little smattering of electricity can give him no end of trouble when, if the engineer thoroughly understands the machinery, he could easily locate or determine the same.

It is not essential that he should cram his head full of the theory of that "mysterious force," but he should endeavor to post himself thoroughly as to the care and running of any electrical apparatus which may be placed under his charge. The modern dynamo is, as a rule, a well built machine, and if proper care be taken should require very little attention; but accidents will happen, and many dollars have been lost through the engineer not knowing what to do in case of an emergency. I therefore will endeavor to give you a few hints as to the care of a dynamo and an idea of some accidents which are likely to occur, and the best way to look for and repair the same.

POSITION OF THE DYNAMO.

To begin with the position of the dynamo cannot be too well looked after. More often than not, little consequence is attached to this important point, the dynamo being pushed into some dark, out-of-the-way corner, where not only is it next to impossible to see, should anything go wrong, but where it cannot be kept clean. It is most desirable that the position chosen should be in a cool, dry place, free from dust, where the machine can be readily seen and of easy accessibility. This condition is not difficult to fulfil, and the engineer will benefit by it in the end. Plenty of room on all sides should be allowed, as it is not the most pleasant thing in the world to handle in cramped corners a dynamo which may be running at a high rate of speed and voltage.

In choosing a place for a dynamo the switchboard must not be forgotten. It is true that there may be but one switch and fuse block, but it is important to have them where they can both be seen and reached without loss of time. If possible, place the switchboard and dynamo where they and the engine can be readily seen from one point, and where, in case of emergency, they may be reached with the least possible delay. For instance, if a fuse blows out it should be in a position where it would be quickly noticed. The chief object in selecting a place for the dynamo which is free from dust is that dirt is one of the electrician's greatest enemies, and it can be safely said that over fifty of the so-called diseases of dynamos may be traced to this cause. A dynamo, in fact, any kind of electrical apparatus, can-

not be kept too clean. In cleaning, merely a general wiping is not sufficient, but thorough inspection of every part, for it is the dirt in the out-of-the-way corners which gives the trouble.

THE COMMUTATOR.

In cleaning and inspecting a dynamo, perhaps the most important part to be attended to is the commutator. This, if it has been properly looked after, should have a dark polished surface, and every effort should be made to keep it in this condition. This can only be acquired by cleanliness and proper adjustment and care of the brushes. **FIRST:** See that no dirt has lodged between the segments or between the lead wires where they join the commutator bars. (A stiff dry brush is useful for this purpose). This is important, as many an armature coil has been burned out owing to short-circuiting at the commutator, caused by dirt or copper dust accumulating at the points mentioned. **SECONDLY:** The commutator may be running sparkless, and no fear of trouble suggest itself to the engineer. When the machine is stopped, however, careful inspection may show signs of burning along the bars. This should be remedied at once, for if allowed to remain the result will be badly sparking brushes and development of flats in the commutator. A fine file should be used to smooth the burnt parts, or if too far gone the commutator should be slightly burned down. This latter practice is nearly always necessary in the use of flats. It is difficult to explain just how these flats occur; there are three or four causes possible: (1) One of the bars may be of softer copper than the rest, and so wear away faster, but this is not likely; (2) a partial disconnection in the armature at the part connected to the particular flat bar, will cause a spark at every half revolution, so biting away the bar. The trouble in this case will, in all probability, be found where the lead wires join the commutator; (3) another cause of flats is a badly balanced armature, which, vibrating badly when running, will cause the brushes to jump and spark, burning away one or more of the segments. If the commutator is a new one, particular attention should be paid to keeping the segments firmly held in position. This can be done by tightening the nut or nuts at the end of the commutator. The commutator should frequently be smoothed with fine sandpaper and oiled until a finely polished surface is obtained.

As before mentioned the proper adjustment of the brushes plays an important part in the care of the commutator. There is no part of the dynamo that will give the novice more trouble than the brushes, and here again let me impress upon you the importance of cleanliness. A clean, well trimmed brush, properly adjusted in its holder, screwed down to bear against the commutator with just sufficient force to prevent jumping and consequent sparking and yet not so hard as to cause excessive wear, should give little trouble, provided the commutator is in good condition. See then that each brush is properly trimmed; that is, cut square across, and if copper, filed off at the proper bevel. If carbon the brushes should first be placed in the brush holders and a coarse piece of sandpaper inserted between them and the commutator. Then by rocking the rocker-arm the brushes are worn away to the shape of the commutator.

There is no general rule for the thicknesses of brushes, but one and one-half the thickness of the commutator bar is near the mark. The object is to have the brush wide enough to short circuit each section of winding for a certain brief time, in order that the current may be reversed; the power of the entire machine being dependent, of course, upon the principle of a rapidly opened and closed circuit creating an induced current. It is much easier to go astray in the thicknesses of brushes when copper is used, as the angle at which they are set is apt to vary. A very good practice is to make a cross section of the commutator, and brush holder full size. Then by drawing in the brush the proper angle can be found, and a piece of wood the shape of the brush can be cut for a template. In adjusting the brushes in the holders, take care that all the leaves, if copper, are in contact the whole width of the brush; if not the result will be a spark, and the longer the machine is allowed to run in this condition the worse it will get. This can be prevented by marking the length on your template and making a gauge to set your brushes to. The same care should be taken to see that the brushes bear on precisely opposite bars of the commutator, or if a four pole dynamo, that they bear on bars that are a quarter of a circumference apart. A very good way is to mark the commutator bars with a centre punch, so that this adjustment may be verified. Having properly cleaned, trimmed and adjusted the brushes, seeing, of course, that they are all firmly screwed to the holders, they should be raised from

* Paper read before the Hamilton Association C. A. S. E., by Mr. Percy Domville, of the Westinghouse Company.

the commutator by the hold-off catches, and left in this position ready for running.

Outside of the commutator and brushes a general cleaning up is necessary. Remove all traces of dirt from the frame, look carefully over all insulators of brush holders, binding posts, switches, field coil, ends, etc., also between the armature and pole pieces, inside the pulley and around the foundation. Turn the armature round by hand to see that nothing catches, and no loose wires or waste are adhering to it, and that the binding wires are loose. See that the oil cups are full and drip properly. If self-oiling, see that the oil wells are full. Then, seeing that all terminals are screwed down tight, the dynamo is ready to run.

STARTING THE DYNAMO.

Just a word about starting the dynamo. First, run your machine with the brushes raised and main switch open to see that all is right mechanically. Before closing the main switch make sure that the voltage is correct and brushes do not spark. To correct the latter fault rock the brushes forward or backward till a sparkless place is found, then close the main switch. I might here mention that it is also important to see that all dirt is removed from the switchboard and connections. Examine and clean occasionally the field rheostat contact and contact shoe.

MISHAPS AND BREAKDOWNS.

It would take too much time to go into all details of the mishaps and breakdowns which are likely to happen in the running of a dynamo, but I will mention a few most likely to occur.

BURNING OUT OF ARMATURES.—It is almost impossible to give any definite rules for the prevention of the burning out of armatures, owing to the probable cause of the trouble being difficult to foresee. Still there are a few points which should be remembered in this connection. As before mentioned, short-circuiting at the commutator is one cause. Burning of insulation under the binding wires will short-circuit the conductors. Short-circuiting in the armature itself is another cause which cannot be foreseen. All that can be done is to let the coil burn out and repair it afterwards. In drum armatures, and in those forms of ring armatures, which are so connected that the windings cross one another, this evil may occur in consequence of the abrasion of the insulation. Short-circuiting between an imperfectly insulated wire and the iron core beneath it is again a fruitful source of trouble.

FIELD MAGNETS.—As a rule, field magnet coils give little trouble, but when they do the difficulty is hard to locate owing to their compactness. Disconnections and short circuits are most common. When there is a disconnection the machine will probably refuse to excite itself. To make sure, the coils should be disconnected at the ends and tested. A common electric bell will tell you if the wire is continuous. If the wire is broken below the surface, the only way to get at it is to unwind it. A short-circuit between any two of the windings will have the effect of keeping the short-circuiting part cool whilst the rest is hot. The coil may be short-circuited on the frame, which can be tested with the bell.

SPARKING BRUSHES.—Any of the following will cause sparking brushes: copper or carbon dust between sections of commutator; copper or carbon dust or oily matter on brush holders causing leak to frame; open circuit in armature, overload, brushes not at neutral point; brushes covering too many segments; brushes not making good contact or loose in brush holder; flats in commutator; too weak a field wire of armature touching pole pieces.

A dynamo that has been giving little trouble suddenly ceases to generate. On examination everything is apparently in good order, and yet it is impossible to get a spark from it. First, look for an open circuit. This may be done with the electric bell, although it is not always a sure test, as a ring may be obtained when a wire is broken and held together only by insulation. Here dirt may play an important part. Look closely for it under the coupling screws, binding posts, and between the brush holder and brush holder rod. A very small particle may be responsible as the following will show: An arc lighting dynamo ceased to generate, in the manner mentioned. By short-circuiting the brushes it was found possible to obtain a flash, while outside of the brushes this was impossible. It was plain, then, where the trouble lay. The brush holder had already been examined, but on again looking, one of the insulators was found to be charred close to the rod for about an eighth of an inch. This was caused by dirt lodging between the insulators and brush holder. It was little, but enough to grind the brush holder on the frame. Other causes for machines failing to generate are explained as follows: A dynamo standing idle for some time may fail to light when

wanted, through a wire in the field circuit being broken and held together only by insulation; or after the connections have been taken apart for the purpose of cleaning, and put together again, trouble has been caused through crossing connections to the field. An expert leaves an engineer in charge of an arc machine, and is called back without loss of time, as the machine will not work, and he finds the switch open in the field circuit. When closed the trouble ceases. In this case the trouble is caused by a matter so trifling as to escape the mind of the instructor.

During a thunder storm a flash was noticed at a dynamo following a vivid flash of lightning, and immediately all lights went out. The dynamo field refused to generate, giving the engineer in charge the mistaken idea that it was burned out. On investigation it was found that the flash had been caused by one of the binding posts short-circuiting on the frame, the result of lightning striking the line.

An engineer, after cleaning the brushes of a dynamo, could not obtain a spark from it. He had forgotten to screw the lower brushes against the commutator. Another, after hunting for a long time, took the cover off the fuse block and found the fuse blown. These experiences, likely to be met with at any time with any dynamo, are worth remembering.

These are a few of those difficulties which will come to every one in the responsible position of electrical engineer. There are many points about every machine which should be carefully watched, and faults to be remedied before they become serious. There is much that can be gained by experience, but a conscientious worker, giving all his mind to his duties, will find himself the gainer, for each day's experience will teach some new point, and what is learned in this way is not soon forgotten.

SPARKS.

The Kingston electric street railway will be extended to Kingston Junction at once.

The Hamilton & Dundas Street Railway have purchased a four motor G. E. 1,000 equipment from the Canadian General Electric Company.

Robert Patterson, who resigned his position as engineer at the Hamilton General Hospital to go to the Klondyke, was drowned in the Athabasca.

Mr. Jacob Morley, of New Hamburg, Ont., has placed his order with the Canadian General Electric Co. for a new 300 incandescent light dynamo, to be run in connection with his present system.

Warton is to have incandescent light. Messrs. Young & Crawford have closed a contract with the Canadian General Electric Company for a 35 kilowatt single phase alternator. Work on the installation of the plant is proceeding rapidly, and light will be turned on in about two weeks.

The Teeswater Electric Light Co., which has taken over the operation of the waterworks and electric light systems at Tees water, has decided to install an incandescent electric lighting system, and for this purpose have placed an order with the Royal Electric Company for one of their 500-light S.K.C. generators with transformers, etc., the work of installation to begin at once.

The Willson Carbide Works Company, of Merriton, Ontario, have recently ordered two additional 150 kilowatt revolving field single phase alternators from the Canadian General Electric Company. These machines will be installed in their No. 3 power house, and with the four already in operation, of the same type, will give a total capacity of 600 kilowatts to be used in the manufacture of carbide of calcium.

The Imperial Electric Light Company supply electric light and power to customers in the eastern part of Montreal. An agreement was announced last month by which the Lachine Rapids Hydraulic and Land Company will supply the Imperial Company with the power necessary to supply this service. The power will be brought from Lachine to the Imperial Co.'s station on Rachel street for distribution.

The Light, Heat & Power Company, of Lindsay, have added to their incandescent plant a 120 kilowatt standard single phase alternator of the Canadian General Electric Company's latest type, with revolving iron-clad armature and compounded to secure automatic regulation. The Lindsay Company have already a 60 kilowatt and 30 kilowatt machine of the same type in operation for several years past, and with their new apparatus will have ample capacity to supply the incandescent lights, numbering between six and seven thousand, connected to their circuits.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO NO. 1.

Toronto Association No. 1 desire to call the attention of engineers to the fact that they intend holding open meetings on the third Wednesday evening of each month. At the meeting in November a lecture will be given by Mr. J. J. Main, the well known boiler maker, on the construction of boilers, which promises to be very interesting. All engineers and manufacturers are invited to attend.

HAMILTON NO. 2.

Hamilton association are holding open meetings of instruction twice a month during the fall and winter. The association is quite prosperous. At the meeting on October 12th an interesting paper on "Dynamo Troubles, and How to Overcome Them," was read by Mr. Percy Domville, of the Westinghouse Company, which will be found on another page. A paper by Mr. E. J. Phillip, Toronto, is also printed elsewhere.

KINGSTON NO. 10.

The meetings of the above association are very instructive and profitable, and much interest is taken in the question box. It is the intention to prepare a set of models of boilers for the purpose of instructing the members in boiler construction, and to show how they should be stayed to strengthen them.

EVAPORATIVE CONDENSER OR COOLING TOWER.

At an open meeting of Hamilton Association C. A. S. E., Mr. E. J. Philip, chief engineer for the T. Eaton Company, Toronto, read by request the paper on "Condensers" presented at the recent annual meeting of the association at Brockville, supplemented by the following:

EVAPORATIVE CONDENSER OR COOLING TOWER.

The evaporative condenser or cooling tower is made to operate where the supply of water is limited, or where it has to be bought. This apparatus is in every way the same as an ordinary condensing plant, except that in addition to the air pump and condenser there is a tower for cooling the water after it has been heated by condensing the steam; its construction will be taken up later on. This apparatus is the outgrowth of the increasing number of steam power plants in recent years with vastly increased capacities, which has of necessity raised the price of the lower grades of coal. Whenever fuel goes up in price, or where the quantity is increasing, due to increased load, the steam user begins to look around for some means of reducing the rising fuel account. During the last few years engineers have had every opportunity to put in what may be called ideal plants, and others have had the opportunity to improve the plants under their control. How far many have succeeded is known only to themselves; if any part is a success it becomes known and is copied or improved on. The principal improvements during the last few years have been due to higher steam pressures, increased number of cylinders, and where water was at all available, running non-condensing; and the absence of water in sufficient quantity to use for condensing purposes at a point where it is desirable to locate a power plant has caused it to be located at some remote or less desirable point. The necessity of having water for condensing purposes being so necessary, it left no alternative.

The cost of running condensing and using water from a city main is out of the question, as it costs more for water than is gained by condensing. This being the case, it formerly left no alternative but to run non-condensing or build the plant where there was an abundant supply of water without regard to the disadvantage of the location. This has been overcome by improvements in an apparatus that has been used for years in a crude form for other purposes. The first purpose it was used for

was for cooling water that had been used for cooling beer. This form of tower was simply a square frame work, filled with brush or limbs of trees; the water was pumped to the top through a sprinkler, and in falling over the loose brush, it spread out in thin sheets over the surface of the wood and was acted on by the air, the warm water causing a current of air to circulate through the filling. The present tower is simply an improvement on the first idea, and when used in connection with a steam engine it takes the place of a natural source of water supply.

With this apparatus a plant can be made to run condensing, with less water than it can run non-condensing. The reason of this I will explain after a description of the tower, which will now be in order: The cooling tower is usually square or rectangular in form, but it is sometimes made round, and is filled with partitions. The partitions may be made of any material. The Worthing tower is filled with tile. The Barnard tower is filled with wire netting, the Gradier with wood, and sheet iron has been used by different parties. Any material that will give a large surface will do, the object of the partitions being to spread the water out in thin sheets over the surface. The partitions do not extend to the bottom of the tower, but a space is left below them into which a fan discharges air. At the top of the tower a distributor is attached to distribute the water over the partitions. Now, the action is this: Imagine an engine condenser and taking its injection water from the bottom of the tower, (into which a quantity is put when the tower is first started). Now, when this water has condensed the steam, and passes on to the air pump, instead of to the pump discharging the water to the sewer, it discharges it to the top of the tower into the distributor, where it is evenly distributed over the filling. It spreads out in a thin film or sheet, and passes slowly down the partitions. The fan is running and its air is passing up between the partitions and acts on the water in three ways, thereby cooling it by the time it reaches the bottom of the tower sufficient to again condense more steam.

The way in which the water is cooled is: First, the water loses some of its heat by radiation from the piping between the tower and condenser, also from the sides of the towers. Next, the air is raised in temperature carrying off heat in this manner, and the last, and by far the greatest cooling effect, is obtained by the air evaporating a certain quantity of the water, carrying off heat in the vapor as latent heat.

I made the statement that with this apparatus a plant could be run condensing, with less water than it can be run non-condensing, and I will try and prove this. Take an engine running non-condensing, and using say 25 pounds of steam per h. p. hour, and taking its water from the city main; if it is say 100 h. p. it will use 2500 pounds per hour. Now, this water is being exhausted out into the air in the form of steam. If we attach a condenser and cooling tower to the engine, and it saves at the engine, say 20%, the engine will use 20% less water, which will make the water consumption 20 pounds per h. p. per hour, or 2000 pounds per hour for the 100 h. p. When condensing, instead of the water passing off as exhaust steam, it is pumped into the cooling tower, and for every pound of water evaporated by the air sufficient heat is carried off to cause a cooling effect sufficient to condense one pound of steam. If all the cooling effect that took place was due to evaporation, there would be water, neither gained nor lost, as there would be as much evaporated as condensed, but as I said before, a certain cooling effect by radiation takes place, and the water cooled in this way can do the work of condensing and is not evaporated. Then the rise in temperature of the air carries off considerable heat without evaporating any water, so that between these two sufficient water is saved to cause a slight overflow from the tower all the time, and as the boilers are using 20% less water, it follows that in this way you are running condensing with 20% less water than you can run non-condensing.

The tower that was built this summer where I am employed is a rectangular structure, 19 feet high, with a vapor stack on the top 9 feet in diameter and 26 feet high, the body of the tower being 10 x 12. It has an 18 inch water space at the bottom and two five foot fans. The filling is 12 feet long. The distributor is made of pipe, and works very nicely. The tower runs in conjunction with a 500 h. p. surface condenser with combined air and circulating pumps, built by the Northey Co., of Toronto. The condenser has 800 brass tubes 8 feet long, making over a mile of tubing, with 1600 stuffing boxes. The water leaving the condenser has a temperature of 120° to 128°; it cools in the tower down to 68° to 80°, according to conditions. It has been cooled down to 10° below the outside atmosphere, and by supplying plenty of air this could be done at anytime.

SPARKS.

The village of Sutton, Ont., will be lighted by electricity.

A new dynamo will be placed in the Russell House, Ottawa.

Leonard Ervin, electrician, Halifax, N. S., is announced to have assigned.

The electric plant at Magog, Que., will be completed before the end of the present month.

We understand that the Eastern Mining Syndicate, of Rossland, B. C., will install a complete electric plant.

The ratepayers of Cote St. Paul, Que., have decided to have electric light. A plant will be put in next summer.

Mr. R. B. Angus has succeeded Mr. G. C. Cunningham as a director of the Montreal Street Railway Company.

Mr. A. H. Deike, of Guelph, Ont., has invented an acetylene gas generator, for which he claims many advantages.

Mr. J. A. Cokers, manager of the Bell Telephone Company at St. Johns, Que., has put in a new long-distance telephone.

The Bridgewater Electric Light Co., Limited, Bridgewater, N. S., has been succeeded by the Bridgewater Power Company.

The Woodstock, N. B., Electric Light Co. is said to have been fined \$50 for failing to register under the electric light inspection act.

W. H. Green, of Wingham, has been given the contract for electric lighting for Listowel, Ont., and will erect the power house and put in the plant at once.

An English syndicate, with large capital, is said to be negotiating for the purchase of the franchises of Canadian lighting companies, both gas and electric.

The Bushnell Oil Company have just completed extensive works at Sarnia, Ont. The works cover over 13 acres of ground, and cost upwards of \$175,000.

The Canadian General Electric Company are installing a 200 light direct current incandescent plant for the North American Bent Chair Company, Owen Sound, Ont.

William Peterson & Company, Limited, of Brantford, have put in a 200 16 c.p. light dynamo. It is a 100-volt machine, manufactured by the Stevens Mfg. Co., of London.

The Lake of the Woods Milling Company at Keewatin have ordered a 25 kilowatt, steel frame, multipolar, direct current generator from the Canadian General Electric Company.

The Dominion Electric Heating & Supply Company, of Ottawa, have made a proposition to supply light and power to the village of Papineauville, Que. An exclusive franchise for 35 years is asked for.

The earnings of the Toronto Street Railway Company for the months of July, August and September show an increase of \$35,323 over those for the same period last year, due to Sunday cars and conventions.

Prof. James J. Guest, recently assistant professor of mechanical engineering at McGill University, Montreal, has been appointed professor of mechanical engineering in the Polytechnic Institute at Worcester, Mass.

The formal opening of the street railway at Sherbrooke, Que., took place on November 1st. The service of the road will be about twenty minutes in the city and forty minutes to Lennoxville, a total length of five miles.

The German post-office is experimenting with an invention, an electric typewriter apparatus, which, at a cost of \$125, can be connected with a telegraph wire, and messages which are typed off on the keyboard at one end reproduced at the other end.

The bankrupt stock of C. W. Henderson, Montreal, has been purchased by Geo. Clime. The electrical supplies, amounting to \$2,639, sold for 44 cents on the dollar; manufactured goods, amounting to \$1,081, 32 cents; and the machinery, value \$801, at 76 cents.

Mr. W. C. McDougall, a well-known mining man, is reported to have organized an English company to build smelters at Grand Forks, B.C., in connection with which electric tramways will be employed for carrying the ore. The company is capitalized at \$2,000,000.

The Chatham Gas Co., of Chatham, Ont., who have been operating an arc and incandescent plant in that town for the last ten years, have decided, owing to the corporation installing a plant and doing the street lighting, to go more extensively into incan-

descent lighting, and for this purpose have purchased a 2,000-light alternating dynamo from the Royal Electric Co., which is to be installed at once.

The City Council of St. Thomas, Ont., has decided to submit a by-law to the ratepayers on Tuesday, November 30th, to guarantee the bonds of the street railway to the amount of \$50,000 and pay the first year's interest, in consideration of the horse car railway being electrified.

The village of Iroquois, Ont., defeated a by-law last month to borrow \$8,500 to purchase an electric light plant, the majority being twelve votes. There is said to be a good opening there for a private company to put in a plant, as the corporation have a wheel pit, intake pipe and tail race.

It is rumored that Mr. H. B. Spencer will resume his former position as assistant superintendent of the eastern division of the C.P.R. Mr. Spencer's position as manager of the Hull Electric Railway is being temporarily filled by Mr. John Brown, the superintending electrician.

The Minister of Public Works proposes to ask parliament for a large vote for extending the government telegraph lines in the Northwest and British Columbia, where already the Dominion government owns 700 miles of telegraph lines. The department is at present considering whether it will be better to extend the present line from Quesnelle, B. C., to Dawson, which will be a long way through a wild and unknown country, or simply to build a short line, about 70 miles in length, across the Chilcot pass, connecting Dyea with Teslin lake.

The annual meeting of the Standard Light & Power Company was held in Montreal last month. The agreement made by the directors for the purchase of the 1,000 horse power from the Lachine Rapids Company was ratified, the power to be distributed by the Standard Company in the centre of the city. The following board of directors was elected: Messrs. J. H. Burland, Peter Lyall, W. S. Evans, W. McLea Walbank, L. H. Henault, Ste. Cunegonde; F. Dagenais, St. Henri, and M. P. Davis, Ottawa. At a subsequent meeting of the board the following officers were elected: Mr. W. McLea Walbank, president; Mr. J. M. Burland, vice-president; Mr. E. Craig, secretary.

Mr. Adam Rutherford, formerly secretary-treasurer of the Hamilton, Grimsby and Beamsville Electric Railway Company, recently entered action against the company claiming \$5,000 damages for alleged wrongful dismissal from the position of secretary-treasurer, and \$833 salary in arrears. Mr. Rutherford was the promoter of the company, and was awarded \$2,000 stock in payment of his services, and subsequently engaged as secretary-treasurer at a salary of \$800 a year, to date from March 1st, 1894. The defence alleged that the grant of stock covered payment for his services until a year later. After a conference between the parties a settlement was arrived at under which Mr. Rutherford received \$233 and each side paid its own costs.

The Electrical Engineer states that figures recently compiled from nearly 1,100 plants, with 300,000 lights, scattered over 40 states, and including stations of all sizes under all conditions, show the general average contract price for arc lights, burning 3,326 hours a year, with coal costing \$3.03 per ton, to be \$101.18. In Pennsylvania, where coal costs \$1.56 per ton, the average price is \$85.75, while in Ohio, with coal at the same price, the average cost is \$78.87. But in Pennsylvania the average burning is 3,931 hours per year, whereas in Ohio it is only 3,350 hours. In California, with coal \$7 per ton, the average price per light is \$119.68, while in Colorado, with coal at only \$3.18, the lamp price reaches \$129.31. It will thus be seen that the average price of arc lighting depends largely upon local conditions, cost of labor, fuel, etc.

The term 'horse power' when applied to a boiler is always misleading, says Power, besides being a misnomer to start with. A hundred horse power boiler will supply steam for a modern engine to develop 200 horse power. The term should be avoided when speaking of boilers whenever it can be gracefully done, and we notice with gratification that an English writer says of water-tube boilers that 'the approximate cost erected is £90 per 1,000 pounds evaporation.' That is to say, you can buy and erect for £90 enough boiler to evaporate 1,000 pounds of steam per hour. You can use the steam in a pump at an expense of 200 pounds per hour per horse power, making the boiler supply five horse power, or in a compound engine at an expense of 13 or 14 pounds, making the boiler supply 70 horse power, or you can use it for boiling glue and generate no horse power at all.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC POWER FOR TRUNK-LINE RAILWAYS.

THE subject of the application of electric power on trunk-line railways, and the extent to which this power is likely to be employed in the near future for trunk lines of considerable length, is just now attracting much attention from electrical engineers, manufacturers and capitalists. In the *Engineering Magazine* for October the subject is very ably dealt with by Mr. George Forbes, the designer of the Niagara power plant. After pointing out that in many cases the circumstances differ, and that the amount of suburban traffic, facility of obtaining water power for generating electricity, and other special features must all be considered in weighing the advantages of the electric over the steam road, he makes the following reference to the Niagara Falls Park and River Railway, as being constructed and operated on the same principles as a steam railway :

"This railway is 12 miles long, of double track, resembling in every way the standard adopted by the Canadian Pacific Railway. The maximum speed attained is 30 miles an hour. Trolley wires are used. There are two motor houses ; one at the falls, worked by water power, the other a small auxiliary station at the Queenstown end of the road, with steam plant. There is 15 minutes' headway between cars, the average speed, including stoppages, being 13 miles an hour. Locomotives, in the ordinary sense of the term, are not used, but twenty-two motor cars supply this service, and are followed by trailers, etc. Some of the cars, when fully loaded with passengers, weigh more than twenty tons. There are eight regular stopping-places along the line, furnished with platforms. This railway has been referred to, not because of any special merit which it possesses, but because it is not a street railway, and because it shows a method of working. In fact, reference is made to it partly to draw attention to the extremely objectionable feature of it. When water power was available, it was not good policy to use steam power at a distance of 12 miles. Of course, if the electric pressure were only 500 or 600 volts, there would be a great waste of energy or an enormous expenditure of copper in carrying the current to even that short distance ; but there would have been no difficulty in transmitting electrical power at high pressure, transforming it down, and converting it into a continuous current. This would have saved nearly the whole expense of working the steam plant. It is important to give attention to this matter of the use of water power on trunk railways. There has been an absurd hesitation to undertake the transmission of power to great distances. If engineers who have had experience in the transmission of power and in the conversion of alternating into continuous currents would look into this question, they would be convinced that where water power is available it is generally economical to transmit electrical power hundreds of miles for working railways. As an example, it can be proved that, if the railway companies of Scotland were to combine to work their trunk lines by means of electric locomotives, the electric current being developed by the water power which exists in that country, then the whole of that service might be carried on without the use of steam locomotives.

Another lesson to be drawn from a careful consideration of the subject is that the waste of coal on steam locomotives is not by any means compensated by the extra cost and loss of power in electrical transmission. Estimates have been prepared which show that not only is the cost of copper prohibitive, but that the efficiency of the electric system renders the consumption of coal with stationary engines about as great as with locomotives. This is certainly not the case. The cost of electric transmission, when properly effected, is not comparable with what it is as calculated on the lines adopted in the past ; and, on the other hand, the efficiency of dynamos and motors has not been sufficiently considered in street railway practice in the United States. A very large part of the success of the Liverpool Overhead Railway is due to the high efficiency of the electrical machinery."

Reference is then made to the Baltimore tunnel, operated by electricity, the Liverpool overhead railway, and the City and South London electric railway, each of which possesses distinguishing features, and in the operation of which electric traction has been successful in competition with steam.

The reason why trunk lines have not been worked by electricity is claimed to be because the cost of transmitting electric power has been considered too great. The author points out that in a great deal that has been written on the subject it has been assumed that the electric pressure upon the feeders is only some 600 or 700 volts, while it is an indisputable fact that the feeders may be supplied with current at 10,000 volts or more, which may be in the form of continuous current, but which is more manageable as an alternating current.

At different stations along the line it would be reduced in pressure by means of transformers, and converted into continuous current by means of a commutating machine. It is in this point that machinery for working the proposed system has been the least developed. The commutating machine now on the market, introduced first by Mr. Shuckert in Germany, and applied in various factories at the Niagara works, is usually called a rotary transformer. It does its work admirably, but it is expensive, cumbersome, and requires continual attention. This last fact renders it impossible to lay such machines along a trunk line at distances of a few miles. But I have prepared the designs for a transforming and commutating machine free from all the defects referred to, which can be manufactured at small cost. After wide experience and laborious study of the whole question, the opinion of the present writer is that, as a rule, electric locomotives, with the power developed by steam, would, if the work were carried out on proper lines, be cheaper than the steam railroad up to a distance of between 40 and 50 miles from the power station. If water power were available for generating the electricity, the distance at which steam power would begin to be the cheaper on a busy line is several hundred miles. These statements are the result of calculations with coal at a dollar and a half per ton. This economy arises from the well-known fact that in the best trial tests of locomotives five pounds of coal are required for the h.p. hour, and from the fact, equally well known, that so good a result is rarely attained, in nearly every case the consumption of coal being several times as much as that

indicated. These conclusions, however, do not give much encouragement for the substitution of electricity for steam, except in special cases. A time may come when special railroads will be built over long distances to be worked electrically, and in that case there are advantages of a totally different character which will favor electricity, depending upon the fact that the locomotive will be abolished and power applied to every axle of the train.

The conclusions arrived at by Mr. Forbes, from many years of study, are as follows :

(1) In cases where water power is always available within a few hundred miles of a trunk line of railway, it is probable that economy would be served by introducing electric traction.

(2) In the case of an independent system of railway to be constructed in a new country utterly unaffected by the traffic from steam railroads, power can be applied to every axle of the train ; wherefore it will be economical in such a case, in construction and in operation, to use electric propulsion in preference to steam.

(3) For desert railways, where water cannot be obtained, electric traction is eminently suitable.

(4) In underground railways, such as the Baltimore tunnel and the London underground system, where economy is not so important as convenience and comfort, electricity must be employed ; and, where such railways are to be constructed, economy makes electricity advisable.

(5) In cases of suburban traffic electricity would help to overcome the competition with street railways by supplying the public with separate and independent cars running at very frequent intervals on a well-maintained track.

CREATING TRAVEL ON ELECTRIC RAILWAYS.

A MANAGER of a successful street railway, referring to the working up of excursion business on trolley roads, says :

"On a steam road the company asks its patrons to spend dollars, while on a trolley system we ask them to spend nickels, so how much more will they be open to persuasion? A resort to which a steam road carries passengers costs at least a dollar to reach, and it is an excursion people think about before taking, and they do not take it very often. With a nearby resort, reached by a trolley line, a man will make up his mind on an instant, perhaps, on seeing an advertisement. He can reach there in an hour or less, and it only costs 5 cents, and with a few more nickels he can spend an enjoyable evening. There are thousands of people who have a quarter, or 50 cents to spend who will go to a nearby resort in the evening if they think they can have a good time, and many of them have families they will take with them. It is my business to tell them where to go and what to do when they get there. For that purpose I keep in touch with all the proprietors of the summer resorts around the city, and just as soon as a novelty is introduced I let the people know of it, either by means of placards on the cars or else I fix up some sort of an attractive circular, always striving to avoid the commonplace."—Street Railway Review.

The receipts of the Hull Electric Railway for this year have exceeded those of last year by \$31,000. The company contemplate building a fine boating and bathing house at Queen's Park, Aylmer, next spring.

SPARKS.

There is talk in Brantford of an electric road to Paris, a distance of seven miles.

Toronto capitalists are said to contemplate the construction of an electric railway between Woodstock and Ingersoll.

This year the Montreal Street Railway Company have placed 36 new cars on their lines. About 200 cars all told are now in use on the company's lines.

The street railway in Victoria, B. C., is being greatly improved. Government street is being double-tracked, and a large number of new motors brought into use.

The Sarnia Gas & Electric Company are installing a 60 kilowatt Canadian General Electric single phase standard alternator to meet the demands of their rapidly increasing incandescent lighting business.

The number of passengers carried by the Quebec electric railway is said to have reached 243,000 during September. The new stock of \$80,000 issued to raise the total stock to \$400,000 was at once taken by the former stockholders.

A movement is said to be on foot in Peterboro for the purchase from the Grand Trunk Railway Company of the lines of railway extending from that town to Lakefield and Chemung, with a view to their conversion to electric roads.

The electric street railway is a great benefit to Ottawa. The average number of men employed is 300 and the pay roll \$10,000 per month. When the company commenced business three years ago they had eight cars, now 100 are necessary to conduct the traffic of the road.

It is rumored that a movement is on foot to construct an electric railway from Oshawa to Toronto, equipped to carry passengers and farm produce to the city. The promoters aim to interest prominent men in the municipalities along the route in the enterprise and induce them to become stockholders.

Mr. H. A. Dauphin, manager of the Bell Telephone Company, at Quebec, recently received from Hamburg a submarine cable to replace the one between Quebec and Levis, which was destroyed last winter. The new cable rolled up formed a cylindrical mass four feet wide and eight feet in diameter, and weighed 18,000 pounds. It was 3,000 feet long, 2½ inches in diameter and contained six wires.

A suit for \$100,000 damages was recently begun at Osgoode Hall, Toronto, by the Toronto and Richmond Hill Street Railway, against the township of York. The suit arises out of the failure of the township to permit the company to build its railway through the township to Richmond Hill. Four miles of track were laid, and ten or twelve miles remained to be completed. The people of the township voted for the issuing of \$60,000 in debentures, and afterwards the council failed to carry out their decision.

The Montreal Street Railway Company have declared a semi-annual dividend of four per cent., and in addition a bonus of one per cent. It is said that the forthcoming statement will show that the company has made during the past year a good sized decrease in operating expenses. The expense of operation in 1895 was \$9,200, and in 1896 was cut down to \$6,480. This year it is not expected to be within two per cent. of as much as last. The earnings, over and above all dividends, expense of operation, etc., last year amounted to \$102,106.70.

The Chateauguay & Northern Railway at Montreal are making preparations to handle an extensive freight business in connection with the Canadian Pacific Railway. They have ordered from the Canadian General Electric Company, four motor G.E. 1,000 equipment, with four motor controllers and commutating switches. This outfit, though of less capacity, is similar to the large locomotive recently supplied by the Canadian General Electric Company to the Hull Electric Company, which has handled as many as thirty-three cars on a shunt.

A company is said to have been organized at Hamilton under President Myles, of the Hamilton, Grimsby and Beamsville railway, with a capital of \$200,000, to extend the electric railway from Beamsville to St. Catharines, a distance of 12 miles. The line will follow down the Queenston stone road, and be commenced, if nothing prevents, in the spring. Much activity is also being shown among the promoters of the electric road between Hamilton and Guelph. Mayor Hewer, of Guelph, is in correspondence with the authorities at Hamilton. This road would have been built months ago, but for the opposition of the farmers of Watford and Mountsberg.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the elementary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.

SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.

CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.

SQUARE AND CUBE ROOT—Definitions and explanations of.

SAFETY VALVE CALCULATIONS—(Spring and Lever Type)—Principles of, with practical demonstrations.

BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

Wm. THOMPSON.

[ARTICLE VII.]

STRENGTH OF BOILERS.

A STANDARD boiler, constructed in accordance with the Canada Steamboat Act, is assumed to have a maximum working pressure of one hundred pounds to the square inch and be forty-two inches in diameter, and, if made of best refined iron plate, shall be at least one-quarter inch thick, made in the best manner.

If boiler is made of steel, a maximum working pressure of one hundred and twenty-five pounds to the square inch is allowable; diameter and thickness of plate as above.

The tensile strength of the material for iron is to be taken as 48,000 pounds per square inch of section with the grain, and 42,000 pounds per square inch across the grain, and for steel 60,000 pounds per square inch. And when boiler and all joints are constructed in best manner, four may be taken as a factor of safety.

From the foregoing standard it at once becomes apparent that the required thickness of plate varies directly with the diameter of the boiler, and the safe working pressure varies inversely with the diameter.

From this we might construct the following formula to obtain the safe working pressure of any boiler:

$$\frac{TS \times 2T}{D \times FS} = p$$

Where TS=tensile strength of material,

2T=twice thickness of plate in inches,

D=diameter of boiler in inches,

FS=factor of safety,

P=safe working pressure.

It becomes evident, however, that since plate must be somewhat weakened by having holes drilled or punched in it to receive the rivets by which the plates are fastened together, and that the rivets themselves must have a direct effect on the strength of the seam, it is necessary first to determine the strength of the punched plate at the joint as compared with the solid plate, and also the strength of the rivets as compared with the solid plate.

The well-known axiom that the strength of a chain is its weakest link is borne out here in a remarkable degree, and the weakest part of a boiler is certainly the strength of that boiler.

Consequently, before we can determine the safe working pressure of a boiler, its required diameter or required thickness of plate, we must first determine strength of all rivetted seams.

It is self-evident that the strength of any section of plate must be its width multiplied by its thickness, multiplied by the weight required to break it.

For example, let us assume we have a piece of boiler plate one inch in width and one-quarter inch thick, and that it broke when a weight equal to 48,000 pounds per square inch of section had been applied to it. We should require to exert a force equal to $1" \times .25" \times 48000 = 12000$, which is the greatest possible strength we may expect to get per sectional inch of this plate.

Suppose, now, we drill a hole in the centre of this plate, we clearly reduce its sectional area and consequently its strength. Obviously, then, both the pitch of the rivets and their diameter must be taken into consideration in computing strength of plate at seams as compared with the solid plate, and we might say that width of plate in inches minus diameter of rivets, multiplied by number, and difference multiplied by thickness of plate in inches, multiplied by

tensile strength of plate per square inch of section, will equal strength of plate at joint, or

$$p = (d \times n) \times T \times TS = s;$$

and since we want to know what percentage of strength punched plate bears to solid plate, we may modify this formula and get the formula required by Board of Trade Rule:

$$\frac{(p-d) \times 100}{p} = \text{percentage of strength of plate at joint as compared with the solid plate.}$$

We now have found the strength of plate when prepared for the rivets, and must now consider the strength of the rivets employed to fill up these holes, so that the operation of making the seam may be completed.

As already seen, the plate has been weakened by having had holes made in it. We now proceed to fill up these holes with rivets, and I need hardly point out that if the strength of the plate is greater than the strength of the rivets, and the boiler loaded to the strength of the plate, the rivets will give out by shearing across. We endeavor to get as strong a joint as possible, and for this purpose put in as many rivets as practicable in a seam. Suppose, however, we put the whole of the rivets in one row, we have reduced the plate area, and the stronger our rivet section becomes the weaker becomes the sectional area of the plate at the joint.

Therefore it is customary to divide the rivets into two, three or more rows, as by doing this the same strength of rivets is retained and the rivets are pitched a reasonable distance apart, enabling a fair percentage of strength to be obtained in the plate.

Then, if we knew the shearing strength of rivets per square inch of section, we may say that $d^2 \times .7854 \times Ss$ =shearing strength of rivet when only one row of rivets is used. Then $d^2 \times .7854 \times Ss \times N$ =shearing strength of rivet when two or more rows are employed.

Where d^2 =diameter squared,

.7854=constant,

Ss=shearing strength of rivets,

N=number of rows of rivets.

Then,

$$\frac{d^2 \times .7854 \times Ss \times N \times 100}{p \times T \times TS} = \text{percentage of strength of rivets as compared with solid plate.}$$

Since both shearing and tensile strength of plate may be considered as equal, we may cancel these and proceed to get strength of rivets by formula adopted by Board of Trade:

Where

$$\frac{a \times N \times 100}{P \times T} = \text{percentage of strength of rivets as compared with solid plate.}$$

Where a=area of rivets,

N=number of rows,

P=pitch in inches,

T=thickness of plate in inches.

From these two formulae, then, may be ascertained both the strength of plate and rivets as compared with solid plate, and it follows that the least of these percentages is the strength of the joint.

NOTE: When rivets are exposed to double shear, percentage of strength obtained from foregoing formula may be multiplied by 1.75.

Example (1): Find the strength of plate at the joint as compared

with solid plate if the rivets are $\frac{1}{2}$ inch in diameter and pitched at $2\frac{1}{2}$ inches.

$$\frac{P-d}{P} \times 100 = \frac{2.5-.5}{2.5} \times 100 = 80\%,$$

strength of plate at joint as compared with solid plate.

Example (2): Suppose that pitch and diameter of rivets in a double-riveted joint are same as in example No. 1, and thickness of plate equals half an inch, what will be the strength of rivets as compared with solid plate?

$$\frac{a}{P} \times \frac{n}{T} \times 100 = \frac{5^2 \times .7854 \times 2}{2.5 \times .5} \times 100 = \frac{393}{1.25} = .3144 \times 100 = 31.44\%,$$

strength of rivets as compared with solid plate.

As a rule it is understood that diameter of rivets may be same thickness as plate, but with thin plates this rule will not hold good, as in the present case it is evident that strength of rivets at joint is far too weak, and it would simply be absurd to construct a joint on these proportions. To increase strength of rivets we must either decrease pitch or increase diameter of rivets. It is considered good practice to have the percentage of strength at the joint or seam 70% of the strength of the solid plate. We can therefore decrease the percentage of strength of the plate by increasing the diameter of the rivet to $\frac{3}{4}$ of an inch, and at the same time increase the strength of the rivets.

Then,

$$\frac{P-d}{P} \times 100 = \frac{2.5-.75}{2.5} \times 100 = 70\%,$$

percentage of strength of plate at seam as compared with solid plate, and

$$\frac{a}{P} \times \frac{n}{T} \times 100 = \frac{.8834}{1.25} \times 100 = 70\%,$$

strength of rivet as compared with solid plate.

It will be readily seen that the most economical joint is one in which the plate and rivet sections are equal in strength. As already pointed out, if one section is stronger than the other it creates a decided disadvantage, as the weakest part of a joint must be its strength, and in a case like the foregoing we might with advantage put half the difference between the strength of the section on to the weakest section.

The easiest way to arrive at this, then, is to equate the formula for the rivet section to that for the plate section:

$$\frac{P-d}{P} = \frac{d^2 \times .7854 \times n}{P \times T}$$

We can now, by a simple transposition of formula, find a pitch that will give equal percentages:

$$P = \frac{a \times \text{No. in one pitch}}{T} + d.$$

Example: What pitch will the rivets of a double riveted seam have to be so as to secure an equal percentage of strength in rivets and plates at the joints, shell plate being half inch and diameter of rivets $\frac{3}{4}$ inch?

$$\frac{d^2 \times .7854 \times 2}{.5} + .75 = \frac{.8834}{.5} = 1.76 + .75 = 2.50 = \text{pitch}.$$

$$\text{Proof: } \frac{2.50-.75}{2.50} \times 100 = 70\%.$$

$$\frac{.75^2 \times .7854 \times 2}{2.5 \times .50} \times 100 = 70\%.$$

I will again repeat these two most important formulae, and recommend the student to commit them to memory:

$$\frac{(\text{Pitch minus diameter of rivets}) \times 100}{\text{Pitch}}$$

equals percentage of strength of plate at joint, as compared with solid plate, and

$$\frac{(\text{Area of rivets } \times \text{No. of rows}) \times 100}{\text{Pitch } \times \text{thickness of plate}}$$

equals percentage of strength of rivets, as compared with the solid plate.

APPLICATION OF OHM'S LAW.

An examination of the preceding article on Ohm's law establishes three important rules, viz.:

1. The current varies directly with the electromotive force or potential, and inversely with the resistance.
2. The resistance varies directly with the electromotive force, and inversely with the current.
3. The electromotive force varies directly both with the current and resistance.

For practical operating engineers, these rules, based on Ohm's law, are the fundamental principles underlying most electrical calculations. It is important that the principles be thoroughly understood, and I regret that, in a work of this kind, full details

cannot be given, for want of space. Before proceeding to an exposition of these principles by mathematical problems, I wish particularly to point out to my readers the desirability of their acquiring literature dealing with fullest details of Ohm's law.

Bearing in mind the fact that these articles are written especially for engineers operating electric plants, I shall content myself with giving principles and formula especially adapted to their requirements.

It may be well to mention that whatever is included in a circuit forms a portion of it. Be it the generator itself, converters, meters, or any apparatus in connection with the generation or transmission of an electric current, and the resistance of both line and apparatus, must necessarily be included in resistance of circuit.

The resistance of a generator is nearly always referred to as internal resistance, and that of the outer circuit or line as external resistance, to distinguish between them, and the two resistances added together form the total resistance of the circuit, or the R of the formula.

Example (1): An electric generator having an internal resistance of 5 ohms and an E.M.F. of 30 volts, sends a current through a line of copper wire whose resistance is 25 ohms; what is the current?

$$C = \frac{E}{R}, \text{ then } 5 + 25 = 30 \text{ ohms total } R, \text{ and } \frac{30}{30} = 1.66 \text{ amperes. (Rule 1.)}$$

Example (2): A difference of potential (E.M.F.) of 110 volts is maintained in an electric circuit, and a current of 250 amperes is the result. What must be the resistance of the line?

$$R = \frac{E}{C}, \text{ then } \frac{110}{250} = .44 \text{ ohm. (Rule 2.)}$$

Example (3): A generator having an internal resistance of 1 ohm sends a current of 50 amperes through a circuit having an external resistance of 2.5 ohms? What is the electromotive force of the generator?

$$E = R C, \text{ then } 1 + 2.5 = 3.5 \text{ ohms total } R, \therefore 3.5 \times 50 = 175 \text{ volts.}$$

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
1....	H.M.	H.M.	H.M.
2....	P.M. 11.10	A.M. 6.10	7.00
3....	A.M. 12.00	" 6.10	6.10
4....	" 1.30	" 6.10	4.40
5....	" 3.00	" 6.10	3.10
6....	" 4.00	" 6.10	2.10
7....	" 4.20	" 6.10	1.50
8....	No Light.	No Light.	.....
9....	No Light.	No Light.	.....
10....	No Light.	No Light.	.....
11....	P.M. 5.00	P.M. 8.40	3.40
12....	" 5.00	" 8.40	3.40
13....	" 5.00	" 9.40	4.40
14....	" 5.00	" 10.50	5.50
15....	" 5.00	A.M. 12.00	7.00
16....	" 5.00	" 1.00	8.00
17....	" 5.00	" 2.00	9.00
18....	" 5.00	" 3.10	10.10
19....	" 5.00	" 4.30	11.30
20....	" 5.00	" 5.50	12.50
21....	" 5.00	" 6.10	13.10
22....	" 5.00	" 6.10	13.10
23....	" 5.00	" 6.10	13.10
24....	" 5.00	" 6.10	13.10
25....	" 6.00	" 6.10	12.10
26....	" 6.00	" 6.10	12.10
27....	" 6.00	" 6.10	12.10
28....	" 6.00	" 6.20	12.20
29....	" 6.00	" 6.20	12.20
30....	" 6.00	" 6.20	12.20
31....	" 6.00	" 6.20	12.20

Total..... 229.50
Grand total..... 2187.25

Specifications have been prepared by Mr. George White-Fraser, of Toronto, for the electric light plant to be installed at Fort William, Ont.

I. J. Gould, of Uxbridge, Ontario, is equipping his plant for the supply of incandescent lighting, and has made a contract with the Canadian General Electric Company for a 30 kilowatt single phase alternating plant.

TRADE NOTES.

Belding, Paul & Co., of Montreal, have ordered a 25 k.w. generator from the Canadian General Electric Co.

Capt. Mann, of the Hillsdale Conservatory, has purchased a thirty horse power boiler from the Goldie & McCulloch Company, of Galt.

The Canadian General Electric Company are installing an isolated direct current plant for the Raymond Mfg. Company, of Guelph.

The Canadian General Electric Company are installing a 60 kilowatt single phase alternating incandescent plant in the town of Magog, P.Q.

The Clayton Air Compressor Works, of New York, have issued a very complete catalogue of their air compressors, containing numerous illustrations, tables and testimonials.

The Canadian General Electric Company are installing a single phase alternating plant for incandescent lighting, for Jacob Morley, of New Hamburg, Ont.

The attention of our readers is called to the announcement in our advertisement pages of the Victoria Tripolite Co., of North Sydney, C.B. This company manufacture Victoria Fossil metal

covering for boilers, pipes and all heated surfaces. Their claims for the advantages to be derived from using this material are supported by testimonials of a number of well-known manufacturing concerns.

The Canadian General Electric Co. have sold a 17½ k.w. steel frame multi-polar dynamo to the Ottawa Gold & Silver Mining Co., of Keewatin, Ont.

Messrs. Ducloux & Payan, St. Hyacinthe, Que., have ordered a 200 light direct current incandescent plant from the Canadian General Electric Company.

The large Brodie mills at Hespeler, Ont., are to be lighted by electricity, a contract for a 140 arc light plant having been given to the Stevens Mfg. Company, of London, Ont.

The Robb Engineering Company, of Amherst, received a cable from England a fortnight ago ordering three more Robb-Armstrong engines. They are, it is thought, for a new electric railway in Sheffield.

La Cie Electrique de Roberval, Chicoutimi county, Quebec, have placed an order with the Canadian General Electric Company for a 60 kilowatt single phase alternating machine of the company's standard iron-clad armature, compound type.

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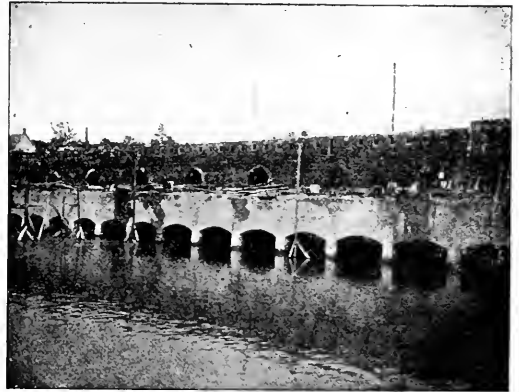
**THE CHAMBLY ELECTRICAL POWER
TRANSMISSION PLANT.**

ALMOST phenomenal have been the strides made in Canada of late years in the development of water power for the generation of electricity. In several instances the power has been transmitted many miles, this being rendered feasible by the perfecting of means by which very high potentials can be controlled with absolute safety. Descriptions of the transmission plants of the Lachine Rapids Hydraulic and Land Company at Montreal, and the North Shore Power Company at Three Rivers, Que., have already appeared in the *ELECTRICAL NEWS*, and in the last number reference was made to the proposed works of the Cataract Power Company, of Hamilton, now in course of construction. In each of these plants engineering practice of high order and of special character has been called into requisition. Of equal importance, both from an electrical and hydraulic engineering standpoint, is the scheme of the Chamby Manufacturing Company, which is now being carried to completion, and which embraces many special features. The following description of this interesting installation, for which we are indebted to the *Electrical World*, will give a fair conception of the completed work :

At Richelieu village, about 25 miles distant from Montreal, the Richelieu River falls through a long series of rapids. From early days a wooden dam between Richelieu village on the one side of the river, and Chamby on the other, has been in existence, supplying power to a few small mills. The new structure which takes its place is one of the finest examples of hydraulic engineering on the continent, consisting of a massive

destructive washing action at the base. A liberal use of one-half inch iron rods, incorporated with the mass of the concrete, gives great strength to the structure, and a surface dressing of neat cement insures the greatest impermeability. This is said to be not only the most carefully constructed, but also the largest concrete dam on the continent.

The dam consists of three portions, two of which run



TWO-STEP DAM FROM BELOW, SHOWING TAIL RACES AND FLUMES.

perpendicularly across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam, and near the right bank of the river, is built the power house. Here the dam consists of two levels, or steps, over which is built a structure of steel beams and brick walls, 308 by 51 feet, for the protection of the machinery. The upper level, which is about two feet above the surface of the water in the lake formed by the dam, will contain the switchboards and controlling devices, and such offices as are necessary. In this part of the dam, eight rooms, or flumes, each about 20 feet square and 10 feet high, are constructed, their arched openings being under the water level, for the reception of the wheels. These, of the horizontal-shaft pattern, number four in each flume, each wheel being 46 inches in diameter. These wheels are mounted tandem on one shaft in two pairs, between the wheels of each pair being a large cast-iron box communicating with the draft tubes, which extend through the solid concrete of the lower step of the dam to a point below the level of the tail water. The draft tubes are built of sheet steel, and are 9½ feet in diameter where they leave the boxes, and 10 feet at their outlet. The upper extremities of these being one behind the other in the line of the shaft, necessitated their construction in a curious skew curve. This installation seems to run to superlatives, since these draft tubes are the largest ever



THE WASTE GATE FROM THE FORE BAY.

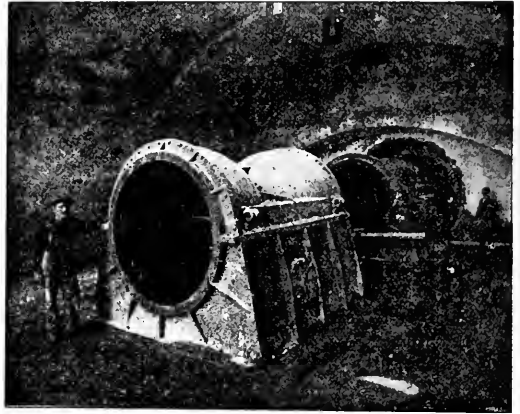
concrete dam, in which, as an integral part, is built the power house, with a capacity of 20,000 horse power. This dam is about 2,000 feet long, 6 feet wide at the crest, and constructed of a concrete composed of the broken rock of the river bed, mortared with sand from the vicinity and American cement. The back is vertical throughout, and the apron is curved so that the overflow water is discharged horizontally, obviating any

constructed. Their bedding in concrete excludes all possibility of leakage, and it is confidently expected that the full advantages of the head of 28 feet will be realized by their use, although the wheels are but a few feet below the level of the intake water. Under this head, and at the speed of 153 revolutions per minute, each wheel will develop 660 horse-power, or a total of 2,640 horse-power to each shaft and flume.

The governing of the wheels will be by means of Giessler electro mechanical governors, similar to those in use at the Lachine plant. These are relay governors, the revolving balls actuating a small lever which closes electrical contact at speeds higher or lower than that for which the instrument is set. These contacts control electro-magnets which operate clutches on the main shaft geared to the gate of each gang of wheels. It has proven an excellent and reliable governor in other large hydraulic installations, notably in that at Lachine Rapids.

At present only four of the eight sets of wheels are being installed, together with two 28-inch wheels, giving 750 horse power for driving the exciters of the large dynamos. The whole of the hydraulic machinery was

the power house dam, a large conduit has been made for the reception of the leads from the dynamos to the switchboard. Lead-covered, rubber-insulated cable will be used for these. In the walls of the power house a number of large terra-cotta pipes, about 3 feet long,



CASINGS FOR FOUR TURBINES IN PLACE IN FLUME.



FLUME AND DRAFT TUBES BEFORE TURBINES WERE SET.

furnished by the Stillwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, and reflects much credit upon that concern by the solidity of its construction and the great accuracy with which the parts of the heavy wheels and draft tubes were assembled at Chambly by its constructing engineer, Mr. H. A. Wright.

The shaft of each gang of turbines passes out horizontally through a circular steel bearing plate on the down-stream vertical face of the upper step of the dam, and is directly connected to a 2000 k. w. generator, giving two-phase current at 60 cycles per second and 12,000 volts.

These machines are of the inductor type, having no moving wire. The inductor is about 10 feet in diameter, and of very massive construction. The single-circular field coil is wound on a brass spool of about 10 inches face by an equal depth, and completely surrounding the inductor. The armature is in two parts. The insulation of these armatures is necessarily most massive and substantial. All the dynamo machinery is now under construction by the Royal Electric Company, at Montreal, from designs by the Stanley Electric Manufacturing Company, of Pittsfield, Mass.

In the space above the flumes in the upper portion of

bent to a quarter circle, with the convexity upwards, have been built in, and through these the cables leading to the pole line will pass out without touching anything between the insulators inside and outside the building.

Two pole lines will be constructed to Montreal, either one being sufficient to carry the load. This construction was adopted to minimize the chances of accidental breakdown, and to make repairs easily possible without danger to workmen. The poles are of chestnut, none being less than 40 feet long. Each pole carries two cross arms, the usual "square" for two-phase transmission being observed. The insulators are of a deeply petticoated porcelain type, somewhat similar to the Niagara pattern, but lacking the grooves for conducting away rain water. They are mounted on oak pins, having a steel rod in the center of each. A line of

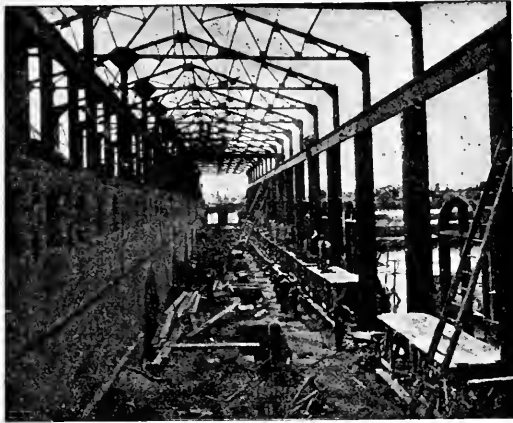


BUILDING THE UPPER STEP OF POWER-HOUSE DAM, SHOWING MANHOLE TO FLUME AND ENTRANCES TO CABLE WAY.

barbed wire is run along the tips of the poles, and four similar lines are attached at the ends of the cross arms, all five being connected together and grounded by means of 8 feet of iron gas pipe at each pole. The line wire is bare, of 00 gauge, and is tied to the insulators by two pieces of No. 12 gauge soft copper wire. A short dis-

tance below the main line a short cross-arm carries the two No. 12 copper wires of a telephone circuit.

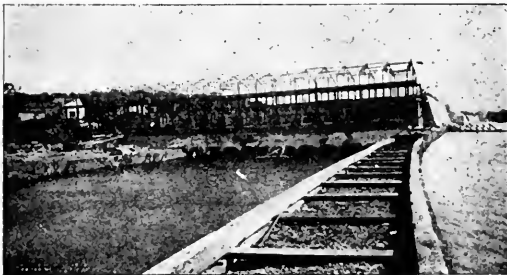
The main power transmission line will end in the electric light station of the Royal Electric Company, at Montreal, where 6,000 horse power will be used for incandescent and arc lighting and direct-current motor



LOOKING DOWN LOWER STEP OF DAM.—POWER-HOUSE FRAMING.

service. The large two-phase generators now employed in that plant for incandescent lighting and power will be re-wound as synchronous motors, and connected directly in the 12,000 volt circuit. These machines will then be belted by a system of countershafts to the arc-light generators and other continuous current machines of the station, to which they will furnish power. A group of static transformers of 150 kilowatts each will be arranged in the basement of the present station, reducing the line voltage of 12,000 for distribution over the present circuits at 1000 and 2,000 volts, two-phase.

The transformers are now under construction at the works of the Royal Electric Company, in Montréal. Their greatest feature of novelty is in the method of cooling employed. The transformer is set up in an iron case in the usual way, this being filled with oil for insulation, and the whole surrounded by a sheet iron water jacket. As the plant in Montreal is some feet below the



LOOKING UP THE TAIL RACE TOWARDS THE POWER HOUSE.

level of the Lachine canal, from which water is obtained under a small gravity head, the water going to the condensers will be allowed to circulate around these transformers in the jackets, and it is expected that this arrangement will result in very effectual cooling.

The troubles with ice, which have been so long a bugbear to many Canadian plants, are not expected to be at all serious at Chambly. The back water from the great dam will make a lake of still water at least $1\frac{1}{2}$

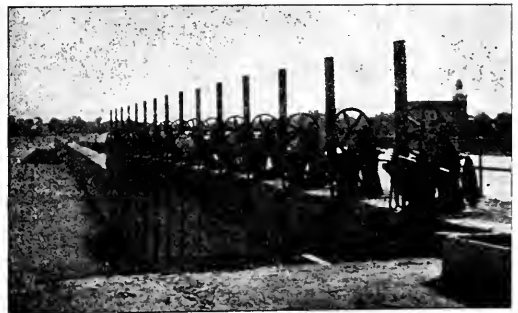
miles long up the river, and, as this will freeze over the surface at the beginning of the season, no trouble whatever is expected from anchor ice. It is expected that floating ice in the spring thaws will clear the dam without trouble. It is a peculiarity of the Richelieu River, which is the outlet to Lake Champlain, that its current is comparatively steady throughout the year, and consequently no difficulties with freshets or low water are anticipated. The construction of the dam and other elements of the power development reflect great credit upon the engineer of the Chambly Manufacturing Company, Mr. J. G. Macklin. The work is progressing at an extremely rapid rate, and the contracts call for the installation of all the hydraulic machinery and the completion of the dam by January 1 next. One of the dynamos is finished and the others are well under way, so it is likely that current will be turned on from this installation in the early spring.

It is expected to deliver nearly 20,000 electrical horse power from this plant in Montreal when the total equipment is installed at Chambly. This will make a grand total of nearly 40,000 horse power sent to that city from two great water powers.

HOW TO MEASURE.*

By W. H. BALLARD.

IN measuring anything it must be compared with a standard, the measurement of which is known.



WASTE GATES.

Examples of common standards are pounds, yards, etc. Although it is generally the case, it is not necessary that that which we measure is greater than the standard. In measuring a surface or area, we take a small portion of the surface (it may be anything, a square foot, yard, etc.) and compare the extent of the whole surface which we do not know with that which we do know. For instance, take a surface 12 ft. square and mark off one square yard in the corner; four of these squares would reach from one side to the other and form a strip one yard wide, and if this strip is repeated until the whole surface is covered, the measurement of the area will be found by multiplying the number of strips by the number of square yards contained in each. No matter how far extended the surface may be, it is measured by this process. Whatever you start multiplying by the result must be; if by feet the result will be in feet, and if by yards the result will be in yards. The same principle is used in measuring any figure, large or small. To take a proportion we have to start with something which we definitely understand. In measuring solids we start with the cubic inch, foot or yard.

This brings us to the second point. In the first place

* Paper read before Hamilton Association No. 7, C. A. S. E., by Mr. W. H. Ballard, Inspector of Schools.

it was shown that measurement consists in comparison. Secondly, it consists in comparing with something else of the same kind. If weight is to be measured it must be compared with a certain definite understood weight, such as pounds, etc. Value is measured by the dollar; area by the square foot or square yard; volume by cubic inches, feet or yards; length by something which contains a certain known length; if any moving object passes through a certain space in a certain time it is a measure of velocity. The surface of a cone is measured by multiplying the slant line by half the surface of the base. To find the cubic contents of a cone, first find the area of the base and go through the process of finding the volume of a cylinder, then divide by three, as a cone equals exactly one-third of a cylinder.

A simple way to find the height of a smokestack is by measuring the length of its shadow and comparing it with the shadow of some object of which we know the length.

The imperial standard of measurement is a bar about 40 or 42 inches long at two points, on which there are two gold plugs, and the difference between these plugs is the imperial yard. In all measurement of length the yard is the standard. Measurements were originally made by comparing objects with parts of the human body, such as the length of the hand, etc., and land was measured by the length of the footstep. The standard of weight is made to depend on the standard of time. All measurements have reference to the three fundamental units—time, weight and length.

MR. HARRIS P. ELLIOTT.

It is with pleasure that we present in this number a portrait of Mr. Harris P. Elliott, who has recently been appointed to the position of Lecturer in "Electricity" and "The Steam Engine" at the Toronto Technical



MR. HARRIS P. ELLIOTT,
Lecturer in "Electricity" and "The Steam Engine,"
Toronto Technical School.

School, in succession to Mr. James Milne. These two courses of the School are very largely attended, and good work is being accomplished.

Mr. Elliott, the new appointee, was born at London, Ont., in October, 1873, his father being of English descent. He entered the School of Practical Science, Toronto, in 1891, and during the following summer was engaged by Messrs. Mallock & Fairbairn, manufacturers of elevators, London, Ont. In the fall he again entered the School of Science for a second year, but on account of illness was compelled to give up his studies. He was then employed for a year by the Canadian General Electric Company in London. He finished

the second year at the School of Science in 1894, and during the summer was engaged upon the engineering staff of the London street railway, in the construction of their Springbank line, under Mr. Kenneth Mackay.

The following year Mr. Elliott took his third term at the school, graduating with honors in 1895. An engagement was then obtained with Dr. Samuel T. Tracey, of New York, handling X rays apparatus. In the college season of 1896-97 he took a post-graduate course, obtaining the degree of B.A.Sc. from Toronto University, with honors. During the past summer he obtained a position on the engineering staff of the Fort Pitt Bridge Company, of Pittsburg, Pa., tendering his resignation to assume his duties at the Technical School.

Mr. Elliott is a nephew of the Hon. Mr. Justice Proudfoot, of Toronto. By his ability and energy the efficiency of the departments under his supervision will no doubt be maintained.

THE PROPOSED STEAM BOILERS ACT.

TORONTO, Dec. 3rd., 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

SIR,—In your November number I see a letter signed "Acadian Engineer," concerning a bill entered at the last session of the Dominion Parliament, in which he takes exception to one of the clauses. The engineers in the west have for several years done considerable work along this line, and we are pleased to hear from our eastern members of the profession, even if it is only to give us his opinion of where we were wrong. There is no doubt but a bill drawn upon the lines he speaks of would be an excellent arrangement for those who have had some technical education as well as some experience, but it would be very hard upon men who had safely operated steam plants for years without knowing exactly what the safe pressure or the tensile strength of the material was. If such a clause was passed what would thousands of our factories do for an engineer? Simply shut down until such a man could be found. I am afraid that if such a law was asked for it would not receive many votes in the House of Commons. A law to be useful must be framed in such a way as not to greatly interfere with present commercial practice, and necessary changes be brought on gradually. Here in the west it has been our experience that it is very much easier to amend a law than it is to get it on the statute books.

What we require is that the government should see and understand the necessity of having steam boilers under the care of accredited men. Once we get this thoroughly established, a law should be enacted that will bring the desired end without hardship to the owners of steam plants. I think if the matter is put into the same position as the steamboat men were at the passing of the Steamboat Act in 1868, we would then have every man now operating a plant secure a certificate to run the plant at which he is employed, and if he should want to operate a larger plant he would have to pass an examination before he could do so. This would have the effect in a few years of raising the standard of knowledge required to operate our steam plants. The western engineers are alive to this, and will be very much pleased to have the fullest assistance possible to get a law passed, and we will never complain if it is as stringent as "Acadian Engineer" says it ought to be.

Yours respectfully,
TORONTO ENGINEER.

The corporation of the city of Lachine are installing in their power house one of the Royal Electric Co.'s 2,000 light alternators.

Mr. Geo. Hartman, of Peterborough, in renewing his subscription to the ELECTRICAL NEWS, writes: "I find it very useful and should not care to be without it."

Mr. J. W. Cochrane, of the Glenboro Roller Mills, Glenboro, Man., under date of Nov. 2nd, wrote the Dodge Pulley Co., of Toronto, as follows: "You should see our rope drive; it is just the slickest thing I ever saw in the way of a drive. If you have any prospective customers for a drive, just refer them to me, will you?"

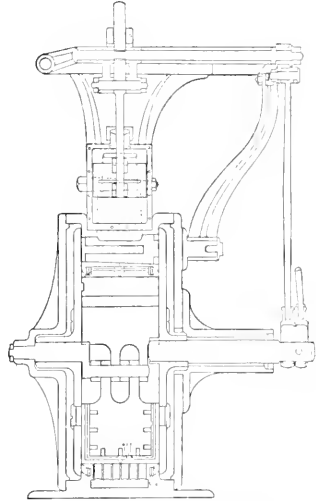
THE TREE ROTARY ENGINE.

MESSRS. Baird & Tree, of Woodstock, Ont., have recently been granted a patent for, and are now manufacturing, a new and improved rotary engine embodying many points of merit. The manufacturers claim that it is especially adapted for service in connection with electric lighting plants, and where economy of space is a consideration, as it only occupies from one-tenth to one-quarter that of the ordinary engine. It is also much cheaper to build. In the accompanying cuts the two elevations of the engine are shown.

Some of the most important features of the Tree rotary engine are: The double casings (the inner ones revolving with the wings inside and being fastened to and a part of the ring piston), which casings almost entirely do away with the friction that has been one great cause of failure in many rotary engines heretofore; a bearing on both ends of the ring piston, one fastened to the main shaft, the other revolving on a stationary shaft, with an offset inside the ring piston casing, making the ring piston shaft; the automatic adjustable metal packing around the wings and wing swivels, the double ring packing between casings and main chamber coming right to the corner of the cylinder, and the automatic adjustable packing between the ring piston proper and the top part of the steam chamber, making the whole engine absolutely steam tight, and thus overcoming another of the difficulties in former rotary engines, viz., steam tightness. The exhaust at the large part of the cylinder gives a forward pressure and a supplemental exhaust at the top, both of which are new. The three intakes of steam for the wings, made

which means economy of steam. The friction is so light that the durability of the engine is certain to be great.

The first part of the cylinder being small where high pressure live steam is used, and the balance of the cylinder increasing in size as the steam expands and gets weaker, and the leverage increasing at the same time, the average pressure on the ring piston is always the same; and the second wing taking the live steam again before the preceeding one exhausts, makes the pressure continuous, and, of course, the absence of all

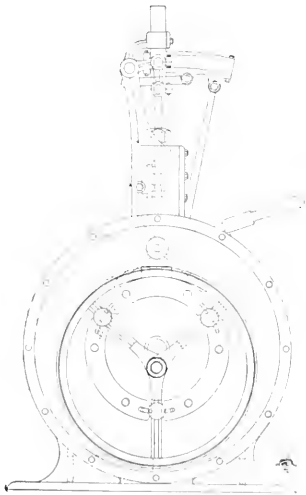


THE TREE ROTARY ENGINE.

reciprocal motion gives the engine a perfectly steady speed.

The manufacturers have already lifted 18 h. p. with an ordinary 12 h. p. boiler running only 600 revolutions per minute. The engine complete, pulley, balance wheel, and bed plate, only occupies two feet square and $8\frac{1}{4}$ inches in diameter inside, 4 inches wide, and only using $1\frac{1}{2}$ inches on the average of the outside of the $8\frac{1}{4}$ inch cylinder. They have used an engine of this size from the 1st of May to the present time, and are now running one ten ton lathe, two smaller lathes, one shaper, two large press drills, emery wheel, etc., in their workshop by this engine. They are building a 75 h. p. engine, which they expect to complete in a few weeks. A test of this engine will be made at the School of Practical Science, Toronto, or at McGill University, Montreal, and the results published.

Persons desiring further particulars of this engine should communicate with the manufacturers, Messrs. Baird & Tree, 39 Finkle street, Woodstock, Ont. Their factory is always open to inspection, and visitors are assured of a cordial reception.



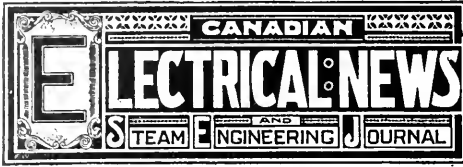
THE TREE ROTARY ENGINE.

with one up and down motion of the valve, utilizes expansion to a much greater degree than the ordinary engine could possibly do, on account of the first part of the cylinder being small. This utilization of expansion is claimed to be the first attempt ever made on a rotary engine that has been successful. Another important feature is the reversing device in connection with the ordinary link motion, making a perfect reverse, and controlled with one lever. All of the above points are believed to be strictly new.

On account of the high speed that is enabled to be attained, it can be connected directly to the shaft of any dynamo, thereby saving friction of pulleys and belting,

Application will be made for the incorporation of the St. Lawrence Foundry Company, to develop water powers and furnish electric light and power in the province of Quebec.

A trial trip of Heilmann's electric locomotive was made on November 13th, the route being from Paris to Nantes. The train hauled by the locomotive weighed about 200 tons. The speed did not exceed sixteen miles an hour. The principle of the locomotive is simple, an ordinary steam engine working a dynamo, the electricity being conducted to motors upon the axles of eight pairs of wheels. The locomotive resembles the hull of a torpedo boat. It is 18 metres long and weighs 125 tons. It is regarded as a great improvement on Heilmann's first engine, and the directors of the railway are said to have decided to adopt it.



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Fuel Economy With Locomotives.

The work of compounding the locomotives in use on the Canadian Pacific Railway lines was begun a few months ago at the company's workshops in Montreal, and is being proceeded with as rapidly as possible. The compounding of these locomotives is said to have reduced the expense per running mile from six to three cents.

THE wattage of lamps is a matter in Wattage of Lamps. which a saving might be effected by central stations. Lamps can be obtained of 60, 54 or 50 watts each. In an average 1,000 light plant probably an average of 6,000 lamp hours per night are supplied. The difference between using 50 watt lamps and 54 watt lamps is 24,000 watt hours nightly, which is almost 50 horse power hours. Putting this at its coal equivalent shows that 50 watt lamps will save about 23 tons yearly over 54 watt lamps, and at \$3 this means \$69 yearly. In order to use 50 watt lamps it is absolutely necessary to have a very close voltage regulation, and this can be effected by a liberal use of copper and careful attention. Five per cent. interest on \$1,400 is \$70, and this liberal use of copper will not cost \$1,400, so that a net saving will result, not to speak of the increased lamp capacity of the machine.

The Power Question in Toronto.

SOME peculiarly interesting questions, having a bearing on electrical matters, have recently come before the City Council of Toronto for consideration, and it seems rather a cause for regret that they have not received a more careful and thorough discussion. The most advantageous, that of lighting and furnishing elevator power for the new city and county buildings, has for long been a cause for not only discussion, but even dissension, among the many advocates of different

methods. As to whether the power shall be purchased from the Toronto Electric Light Co., or generated by a plant placed in the buildings themselves, or by a plant placed in the waterworks pumping house, is a question which cannot be solved by the application of purely general principles without regard to the particular conditions. The Toronto Electric Light Company is, of course, desirous of obtaining the contract, and offered the very reasonable price of 3 cents per k. w. h. It seems doubtful whether the current can be generated in the buildings themselves for such a figure.

Electrical Development.

WITH this number of the ELECTRICAL NEWS the seventh volume of the new series is completed. Taking a prospective glance over the past twelve months, we must conclude that in some respects the year has been one of phenomenal advancement. Perhaps the greatest work has been accomplished in the utilization of water powers for the generation of electricity, in which direction Canada is rapidly coming to the front. The Chambly transmission plant, a description of which appears in this number, possesses engineering features quite on a par with those of the Lachine Rapids installation, while it is not lacking in unique features also. The magnitude and necessary efficiency of these undertakings have naturally called into requisition the employment of the very best machinery, and our Canadian manufacturers of electrical apparatus have demonstrated beyond a doubt their ability to meet the requirements in this respect. Of the prospect for the electrical business we are most sanguine. It would appear that we are on the eve of an electrical era, when electricity will be employed for purposes for which it was never thought of a few years ago. It promises to be utilized for the supply of power, in mining operations, for cooking and heating purposes, and in many fields that will increase its usefulness. With improved commercial conditions such as are likely to be experienced in the near future, the outlook for the electrical industry is quite hopeful.

Advantages of Radial Railways.

IN discussing the question of the enlargement of St. Lawrence market in Toronto, Ald. Lamb referred to the benefits to be derived by the city and vicinity from the construction of radial railways, and pointed out that steps should be taken to induce the building of such roads. We presume that Ald. Lamb had in mind railways operated by electricity, which has proven to be the most economical and satisfactory system for short distance lines. In this respect, considering her commercial importance, Toronto does not compare favorably with other cities in the province. Hamilton is surrounded by suburban roads, each of which is believed to be a paying investment and to have assisted in building up the city. A system of radial railways would undoubtedly prove of equal, if not greater, benefit to Toronto, and every encouragement should be given to legitimate enterprises of this character. The failure of the Grand Trunk Railway Company to successfully operate the belt line road constructed around Toronto a few years ago has probably tended to discourage investment in radial railways. This, however, should not be the case, as the failure of this road, which was operated by steam, was attributable to causes which do not apply to electric railways. We are pleased to learn that a company is now seeking authority to purchase

existing roads, and to build new ones in the County of York, and that the charter includes the taking over of the G. T. R. belt line above referred to.

Candle Power of Arc Lamps.

WE have already had occasion to refer to the candle power of arc lamps, and the very indefinite way of specifying it.

It seems to have become fixed in the minds of a large number of persons that a 9.6 ampere arc lamp will give 2000 candle power, and that a 6.8 ampere will give 1200 c. p. When, therefore, such lamps are put in a circuit, and seem to give a light deemed not up to their standards, disappointment and dissatisfaction result. The manufacturing companies are blamed for trying to sell under worthless guarantees, and the customer considers himself badly treated. Now, it is not the business of this journal to take the part of manufacturers against the public, but we deem it in the true interests of the electrical industry to point out to our operating readers that the above dissatisfaction is most emphatically largely their own fault. A man who does not take the trouble to study the details of a business out of which he makes his living almost deserves to be deceived, more especially when the whole literature of the subject is at his disposal, is extremely interesting, and written in a state to suit not only the technical, but also the popular reader. When purchasing an arc dynamo the purchaser usually asks for a 2000 or a 1200 c. p. outfit, and without giving the matter a moment's thought, concludes that a "nominal" 2000 c. p. lamp will give actually 2000 c. p. If he were to devote to the subject as much thought as he gives to the purchase of a hand lamp for his kitchen—to use oil—it would probably occur to him that just as the amount of light given to his coal oil lamp depends on the quality of the oil, the size of the wick, and whether the wick is turned up or down, so the light given by an arc lamp depends not merely on the current, but also on the quality of carbons, their size, and the distance between their points. As a matter of fact, any one can prove for himself that one can get more light from a 5 ampere lamp than from a 10 ampere one, by simply varying the size, quality and distance of the carbons. An arc lamp is nothing more or less than a mechanism for keeping two carbon rods always a little distance apart, and the lamp itself has no more to do with the light than has the bulb of the hand lamp that holds the oil, or the screw that raises the wick. So that if a purchaser desires to buy arc lamps properly, he should not ask for one of a particular candle power, but for one adapted for the use of a certain current to maintain the carbon rods a certain distance apart, and with a certain drop of potential across its terminals. The candle power is then entirely his own affair, and if he wishes to be very severe in his requirements he will then need to specify that with such a lamp as above, and using carbons of such and such a particular make, the candle power observed at such and such a distance from the crater, and at a specified angle from the horizontal plane passing through the crater, must be what he considers he wants. With a specification such as this he is equipped and is in a position to talk to manufacturers, but to consider himself badly treated and deceived because a lamp bought as a supposed 2000 c. p. does not give it with any kind and size of carbon, and at any distance from the ground, is just about as business-like as to buy a heating stove without saying whether it is to burn wood or coal. As

a matter of fact it has been over and over again proved that a nominal 2000 candle power lamp does not give more than 800 c. p. in the most intense direction with ordinary carbons, etc. If the electrical operating industry would take a hold of its interests a little better and would dictate its requirements it would be better for both operators and manufacturers.

SAMPLES OF SCALE AND FEED WATER WANTED.

Mr. Wm. Thompson has in course of preparation for this journal a series of articles on "Corrosive and Scale Forming Agents in Boiler Feed Waters." To make these articles of special value to our readers, Mr. Thompson wishes to receive from responsible steam users in all parts of the Dominion samples of scale and feed water. It is Mr. Thompson's intention to make complete analysis of the various samples, using them as practical illustrations of the formation of scale through various sources. These samples should be addressed to Mr. Thompson at Montreal West, Que.

ELECTRICAL TRANSMISSION OF POWER THE SUBJECT OF ARBITRATION.

PORT Arthur has been the scene of a most interesting arbitration case, which terminated on the 24th of November, after lasting two weeks. The case in dispute was as to whether one of the contestants should be permitted to divert the waters of the Kaministiquia river, at the head of a rapid on land owned by him, and carry it by means of a canal across not only his own land, but also across that owned by the other party, discharging the water at the foot of a fall 120 feet high which is situate on the land owned by the second party. The question left for the arbitration to decide was as to whether there was, at all seasons of the year, a sufficient quantity of water in the river to allow of the proper supplying of all the power that could at present, and in the near future, be consumed in Port Arthur and Fort William, using the 30 foot "head" that existed on the first contestant's property, or whether the natural flow of the river was liable to go so low that the above amount of power could not be generated except by utilizing the whole head between the top of the rapids and the foot of the fall—amounting to about 180 feet.

In order to properly appreciate the bearing of the mass of technical evidence given on both sides, and which will be of both interest and value to our readers as throwing light on the subject of the electrical transmission of water power, it will be necessary to explain that at a point distant some twenty miles from the towns of Fort William and Port Arthur, situate at the head of Lake Superior, the Kaministiquia river forms the Ecarte rapids, falling about 60 feet in one mile, and then precipitates itself over the Kakabeka Falls into a gorge 120 feet below their crest. In Fort William are four huge C. P. R. elevators, besides repair shops and other power consuming industries, and Port Arthur has one large cleaning elevator. In order to use the power of the Kakabeka Falls it will have to be electrically transmitted over the intervening 20 miles, and it will thus be evident that hydraulic and electrical engineering of a very high class will have to be employed.

The matters to be decided by either observation or argument were: The actual quantity of water in the river at the time of the arbitration, and whether that quantity was likely to be the minimum or not; the amount of power that that quantity of water would enable to be actually laid down in consumers' premises in the towns 20 miles away; and the actual and prospective market for power in the towns and elsewhere. The engineers engaged in preparation of reports and in giving expert testimony were: For Mr. Jenison, who was endeavoring to get the right to use the whole head of 180 feet, Mr. White-Fraser, of Toronto; and for the Kakabeka Land and Power Co., who were striving to restrain Mr. Jenison from so using the whole head, Mr. H. Wilde, chief engineer of the Sault Ste. Marie Pulp Co., who had charge of a portion of the Canadian locks at the Soo; Mr. H. Von Schon, a distinguished United States hydraulic engineer; Mr. H. Rickey, Mr.

R. Hesketh and Mr. J. Armstrong, the last two of Toronto.

A most accurate gauging was made of the river, using current meters, and the probable low water was calculated on the basis of the whole drainage area of the river, taken in connection with the rainfall, precipitation, etc., and temperature reports of the government. Some deductions were made of great interest and value. It appeared that the Kaministiquia river has varied between low and high water from a flow of not more than 5,000 cubic feet per minute in about February, to about 56,000 cubic feet in October, and a vast and totally unmeasurable quantity in floods. But what will probably be of most interest to our electrical readers is the calculations on transmission losses, which showed how much water would be required at 30 and at 180 feet head in order to render available 1,000 horse power at a consumer's shafting 20 miles away. It first came out that the following efficiencies could be depended on for the apparatus mentioned below, in very large units and of first-class construction and design:

Wheels.....	80 per cent.
Generators.....	97 " "
Step-up and down transformers.....	99 " " each.
Large motors.....	97 " "

Giving a total efficiency (leaving lines out of consideration) of nearly 74 per cent., that is, that of each theoretical 100 h. p. in the water, 74 h. p. could be used. The transmission line calculations were even more interesting, involving, as they did, the calculation of the losses of power due to the reactance of the circuit. On the basis of 1000 h. p. laid down in Fort William, 20 miles away, with various voltages and percentages of resistance drop, it was shown that with 15,000 volts—10% resistance drop—it required a loss of 126 h. p. in lines alone to transmit 1000 h. p., not considering the losses in the wheels, etc.

With the above given efficiencies, and using 10%, 15% and 20% line losses for resistance, and calculating therefrom the resultant reactance losses, it was shown that to lay down 1000 h. p. 20 miles away required the following actual expenditure of power which had to be furnished by the water:

To lay down 1,000 h.p. with 10% loss required	1,550 h.p. in water.
" " " " 15% " "	1,694 " "
" " " " 20% " "	1,882 " "

The value of using a high voltage is shown by comparing the result of using 10,000 volts instead of 15,000, as below:

Using 10,000 volts—	
To lay down 1,000 h.p. with 10% loss required	1,694 h.p.
" " " " 15% " "	1,806 " "
" " " " 20% " "	1,908 " "

Comparing the 15,000 volt table with the one given under for 20,000 volts, shows that in all transmissions there is an economical voltage.

Using 20,000 volts—	
To lay down 1,000 h.p. with 10% loss required	1,560 h.p.
" " " " 15% " "	1,617 " "

Calculations as to the cost of the circuits showed that to lay down 1000 h. p. the cost would be as follows:

Using 10,000 volts, with 10% drop, would cost	\$23,760.
" " " " 15% " "	15,850.
" " " " 20% " "	11,880.
Using 15,000 volts, with 10% drop, would cost	11,880.
" " " " 15% " "	7,920.
" " " " 20% " "	4,977.
Using 20,000 volts, with 10% drop, would cost	5,940.
" " " " 15% " "	4,977.

If power were very valuable, that is, if the stream were not very powerful, or if power could be sold at a very high figure, then it would be best to save as much as possible by using 10,000 volts and 10% drop, or 20,000 volts at 10%. But on the other hand, if power were plentiful and could not be sold at a very high price, then it would probably be best to save the cost of transmission by using the highest voltage possible. It is needless to suggest that every case should be weighed on its own merits. In this arbitration it is understood that the result is that Mr. Jenison has proved his point, and as he proposes to undertake the work very soon, a most interesting construction may be expected, involving the transmission of nearly 5,000 h. p. over the long distance of 20 miles.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

ELEVENTH ANNUAL BANQUET OF TORONTO NO. 1.

OVER one hundred persons assembled at the Richardson House, Toronto, on Thanksgiving eve, Nov. 24th, in response to the invitation of Toronto No. 1 to participate in the eleventh annual dinner of the association. The proceedings of the evening were presided over in an able and discreet manner by Mr. G. C. Mooring, president of the association, and near him sat Messrs. A. M. Wickens, the founder of the society; E. J. Phillip, executive president; A. E. Edkins, Registrar Ontario Association; John Fox, past president; T. Eversfield, vice-president; R. C. Pettigrew, Robert Mackie, George Mackie, and J. Hunter, of Hamilton association. Besides a large number of other engineers, there were present the following persons: Mayor Shaw; Prof. Galbraith, principal School of Practical Science; George Anderson, manager Royal Oil Company; John C. McLachlan and F. H. Leonard, of the Toronto Motor Company; James McLaughlin, traveller Samuel Rogers & Co.; John J. Main, Polson Iron Works Co.; John Bayne, city traveller Royal Oil Co.; Joseph Wright, Bennett & Wright Co.; James Milne, Weeks-Eldred Co.; James Sinclair, Eureka Mineral Wool Co.; W. P. Sutton, manufacturer Sutton's compound; Geo. W. Grant, of Geo. W. Grant & Co., oil merchants; Mr. Powers, Vacuum Oil Co.; Alex. Horwood, secretary Toronto Technical School; W. G. Blackgrove, traveller Wilson & Co., oil merchants; O. B. St. John, representing Marine Engineers' Association; C. B. Edler, Montreal; J. Litster, manager Pure Gold Mfg. Co. Shortly after nine o'clock the guests gathered around the tables, and for an hour the menu engaged the attention of all, and no evidence was lacking that it was fully appreciated. During this hour Mr. A. E. Harding furnished choice selections on the piano.

The president welcomed the guests to the eleventh annual dinner. He referred to the formation of the association some twelve years ago, when eleven engineers met in Mr. Wickens' house and took the first active steps. Since that time great progress had been made, and the association now extended from Montreal to Winnipeg. He hoped that before long it would be spread over the whole of Canada. He asked all to join in singing "God Save the Queen." Then followed the toast of "Canada, our Home," coupled with the name of Mr. Anderson, who had recently returned from Japan. Mr. Grant sang "The Maple Leaf." Mr. Anderson said he was sorry they had mentioned that he was an oil man, as they had the reputation of being a pretty slippery and greasy lot. Referring to his visit to Japan, he said he was received like a king, being tendered banquets and otherwise entertained. At Japanese banquets the bill of fare included chestnuts, bamboo, raw fish and molasses. He thought our prospects for trade in the east were very encouraging. We had a country to be proud of, with boundless resources. He was told that there was two hundred and fifty million pounds sterling in England ready to come to Canada for investment. Our trade in the east, he believed, would astonish the world within the next ten years. Our manufacturing industries compared favorably with those of other countries, and the government was doing its duty to assist manufacturers; but business men, if they wished to succeed, should take off their coats and work. That was the only way to get trade. By request Mr. Geo. W. Grant sang "The Land of the Maple," and was followed by a comic song by Mr. Harry Brown. Mayor Shaw arrived just in time to respond to the toast of "Toronto, our Home." He was proud of the progress Toronto had made, and hoped to have the honor of opening the new city buildings next year. Referring to the city's future, he said that while Toronto wanted factories, he believed a greater necessity was to make Toronto an attractive city, a statement to which exception was taken by several of the speakers following. Mr. James Fax here made the usual hit by a comic song, followed by a witty story as an encore.

Coupled with the toast of "The Manufacturers" were the names of Messrs. J. Main, of the Polson Co., F. H. Leonard, of the Toronto Motor Co., and James McLaughlin, of Samuel Rogers & Co. After a song by Mr. Litster, Mr. Main was called upon. Speaking of the engine and boiler trade, he stated that his firm were experiencing a greater demand every day. That trade was improving was shown by the increased enquiries from all parts of the country for boilers and steam power. As to Mr. Anderson's remarks that we could capture eastern trade, he did not think we

could compete with the Chinese and Germans, who were paid low wages, unless by employing cheaper labor, of which he was not in favor. We could not manufacture boilers and compete with these countries. What was wanted was the development of our own resources, we wanted smelting furnaces and rolling mills to work up our own ore and nickle. He did not agree with the Mayor's remarks as to the necessity of beautifying the city. In his opinion it was manufactures that were wanted, and something should be done to bring them here. Mr. Main closed his remarks with one of his humorous stories, and was heartily applauded. Mr. Leonard followed. He agreed with Mr. Main that prospects were never better for manufacturers than at present. Referring to the electrical business, with which he was most familiar, he said the development within the last five years had been wonderful. A few years ago it was almost impossible to find a future for the business, but it had gradually grown, until it was now an important factor in the industrial field. When in Montreal recently he learned that the Dominion Cotton Mills Company had made a contract for 1,500 horse power in a single piece, taking the place of three large engines. This amount of power was delivered at their switchboard, and distributed from there as required. By this means manufacturers were enabled to save power by dispensing with shafting. Toronto was not blessed with great water powers such as were to be found in the vicinity of Montreal, yet it was a good manufacturing point owing to its central location. Even if we had to rely on steam power, he thought there was a great future for the city. He knew of instances where steam power was being supplied at seventeen, eighteen and twenty dollars per horse power per year, with coal at a higher price than in Toronto. There was one point in favor of the steam engine—it was a reliable prime mover and could be depended upon, while you could not always depend on water power. Mr. McLaughlin said that since 1887, with one exception, he had been present at every banquet of the Toronto Association. He compared the working men of to-day with those of the early days, when they could barely eke out an existence. Now, thanks to the inventor and the workshop, they were no longer subject to the tyrannical heck and call of their master. Their position was now almost equal to those who were their employers. He gave some figures of imports and exports, which showed that only during the last two years had our exports exceeded our imports. The tide had recently turned, and we were now on the eve of increasing prosperity.

Songs by Mr. Thomas Eversfield and Mr. W. G. Blackgrove followed. The latter sang "Out on the Deep," and for an encore "Rocked in the Cradle of the Deep." "Educational Interests" was placed in the hands of Prof. Galbraith and Mr. A. G. Horwood. The former said that technical education had grown and developed wonderfully within the last fifty years, and the great gulf between educated and uneducated men had to a large extent passed away. Such education was drawing men closer together and unifying them, and would also have an effect in solving political problems. Messrs. Grant and Fax here sang a duet which created much laughter, some of the verses of which were as follows:

I've just heard some news that will cause you to say,
Oh, goodness gracious!
The engineers, if wish and prosper to-day,
Goodness gracious!
Just ten years ago they were hollid-de-hoys,
And as a society just a few boys,
Now nothing on earth can shake their equipage,
Goodness gracious!

Since then they've increased both in numbers and strength,
And spread over the land its entire width and length;
To judge from this gathering as it now appears,
We'll be as run in the next dozen years,
For if they keep on, we'll be all engineers,
To be at their gatherings is always a treat,<
A jollier set very seldom you'll meet;
From president Wickens to Moring to-day,
And men of their stamp there is none will gainsay,
They meet to do good, and have one to stay.

Mr. Horwood, in responding, referred to the good work of the Technical School. It was attended by a large number of engineers. At the last session of the Ontario House a bill was passed permitting towns to establish technical schools, and there was some doubt as to what effect this would have upon our high schools. Farmers would probably give their sons a scientific education. He was strongly in favor of shorter hours for workmen, and especially engineers.

Mr. E. J. Phillip responded to "The Executive." He said the association was growing gradually, and he hoped they would soon secure a compulsory license law, for which they were now working. In educational matters he believed the Hamilton association was doing the best work of any branch. Mr. Brown sang

"A Hot Time in the Old Town To-night," after which Mr. Wickens, the father of the order, was asked to respond to the toast of the "C.A.S.E." The association, Mr. Wickens said, was founded on principles different from any other society—it was founded on principles of self education, and was essentially and theoretically an educational institution. They could educate the employer as well as the engineer or fireman. The engineers felt they should have a license law. Marine engineers were compelled to pass an examination, and it was more important that stationary engineers, having charge in some cases of plants in factories where several hundred people were employed, should give proof of their competency. They got a permissive law for Ontario four years ago, and in that time 750 certificates had been granted to engineers. After getting this permissive law, the Toronto association commenced to agitate for a Technical School, and succeeded in securing a grant of \$2,000 from the government. That it was a success was shown by the attendance and the fact that the cost per pupil in the public schools was \$36.50 per year, while in the Technical School it was only \$6.60. The Toronto association had collected \$4,500; of this amount between \$70 and \$80 had been spent for assistance to members; \$440 for educational work; \$158 for legislative purposes; \$600 for property and library, and \$400 to the executive. They had assisted 200 members to secure situations, and employers were willing to pay higher wages for the services of members of the association.

The toast of "Sister Societies" followed a song by Mr. Grant. Messrs. Mackie and Pettigrew responded. They spoke of the relationship that existed between the Hamilton and Toronto associations, and of the good educational work that Hamilton No. 2 was doing. They had had some valuable papers, and others were arranged for. Mr. Mackie then proposed the toast of "Toronto No. 1," to which president Mooring replied briefly. The next toast was that of "The Press," which was acknowledged by Mr. Biggar, of the Canadian Engineer, and Mr. Young, of the ELECTRICAL NEWS and STEAM ENGINEERING JOURNAL. After the health of the host had been drunk, the eleventh annual dinner became a thing of the past, amidst cheers for Toronto No. 1.

The banquet committee was composed of Messrs. Thomas Eversfield, chairman, Geo. Thompson, secretary, James Huggett, Samuel Thompson and C. Moseley.



MR. G. C. MOORING.

At Northamptonshire, England, in the year 1857, Mr. G. C. Mooring, president of Toronto No. 1, first saw the light of day. When a robust boy, 17 years afterwards, he removed with his parents to Canada, and found his first employment with Messrs. Thompson & Williams, engine builders, of Mitchell and Stratford, remaining with them for three years, during which time he obtained valuable experience in engine building and general machine work. Upon removing to Toronto he was employed by the Toronto Reaper and Mower Works for three years as machinist, and subsequently by the Massey Manufacturing Company. Then he accepted a position with the Toronto Bridge Company, now the Dominion Bridge Company, but after four years' service the works were removed to Lachine, and Mr. Mooring, choosing to remain in Toronto, assumed charge of the steam plant of the Standard Woolen Mills, remaining there four years. He then went to Brandon, Man., and put in a steam plant in Christie's saw mill, and while there assisted in forming the Brandon branch of the C.

A.S.E. Mr. Mooring returned to Toronto in 1889 to accept his present position with the Methodist Book and Publishing Company, where, besides having charge of the steam and electric plant, he has the entire mechanical superintendence of the establishment. He may be said to be an engineer by inheritance, his father, Mr. James Mooring, being a stationary engineer, and for twelve years has had charge of a steam plant in Toronto for Messrs. Langley & Burke.

Mr. Mooring has always taken an active interest in association work, and claims to have been greatly benefitted thereby. He was a charter member of the order, and the first secretary of the executive, and holds a first-class certificate from the Ontario association. In Toronto No. 1 he has passed through all subordinate offices to his present position.

MEETINGS OF TORONTO NO. 1.

At the regular meeting of Toronto No. 1, held on Wednesday, November 23rd, one new member was initiated. The receipts of the evening were \$110. Bro. Wickens read a paper on the "Indicator," which will be found in another column, and which resulted in an interesting discussion. At the meeting on the 1st inst., the Hall Board was granted permission to purchase a piano for the use of the association and tenants. The Banquet Committee reported, and it was stated that the Engineers' Hand-Book was ready to be turned over to the association. Commencing in January next, the second Tuesday in each month will be set apart for open meetings, to which steam users and engineers are invited. At 2 a.m. on the morning following the last meeting fire was discovered in the Engineers' Hall, 61 Victoria street, which destroyed their furniture, carpets, charter, etc., the damage being estimated at \$200. We are glad to learn that the library was only slightly damaged. It is thought the insurance will cover the loss.

HAMILTON NO. 2.

The Hamilton branch of the Stationary Engineers held an open meeting in their hall on Tuesday, Nov. 8th., president Wm. Norris in the chair. The meeting was well attended and very interesting. Instead of having a regular paper read, a number of questions taken from the question box were answered by some of the members. Pres. Norris explained the difference between an alternating dynamo and a constant current dynamo. He expected a paper going more thoroughly into the subject would be read later on in the season. He also made a few interesting and useful remarks on the construction and use of magnets. Mr. Geo. Mackie gave the formula, and explained the method of ascertaining the amount of horse power to be used by an engine in increasing or decreasing the number of revolutions per minute. He also satisfactorily answered a question on the supporting power of stays. At a later meeting a paper on "Measurement" was read by Mr. Ballard, which will be found elsewhere. The open meetings in connection with this association are very interesting and instructive, and are well attended.

KINGSTON NO. 10.

At the last meeting of the Kingston association an interesting paper was read, which provoked considerable discussion. A number of questions were found in the question box, and these were answered to the satisfaction of all.

DOMINION LICENSE LAW WANTED.

At a meeting held in Engineers' Hall, Toronto, on Nov. 23rd., to consider the question of securing legislation for engineers at the coming session of the Dominion Parliament, it was unanimously resolved that such a measure be introduced, and that all engineers and steam users possible for the committee to reach be communicated with, and their co-operation solicited. President F. G. Mitchell, 276 Talbot st., London, and Registrar A. M. Wickes, 280 Berkeley st., Toronto, will be pleased to furnish all enquirers with data and matter to work upon. A committee was appointed to draft a circular setting out the facts and necessities of the case, which the Registrar will have for distribution in a few days. The committee have had enquiries from Nova Scotia in the east, and British Columbia in the west, regarding such a law, and feel that the movement will be in keeping with the rapid advancement of the affairs of the Dominion at large.

The Ottawa Car Company are building a number of open cars for the new electric railway at Sherbrooke, Que. The company have about completed an extra long double truck vestibule car for the electric line running between Grimsby and Hamilton.

THE INDICATOR.*

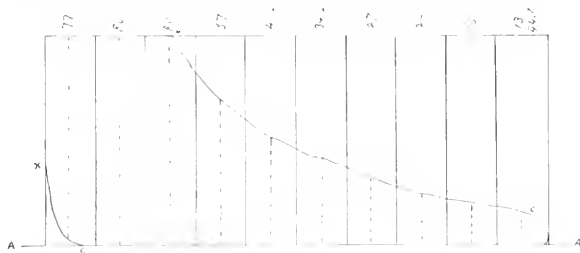
BY A. M. WICKENS.

AT our last talk about the indicator we went into the matter of explaining the different motions to show the necessity of having the instrument carefully handled and connected with the cylinder for the pressure, and with some of the reciprocating parts of the engine to represent exactly the motion of the piston upon the revolving drum. It is imperative that the instrument shall be in perfect order, to insure accuracy. One means of testing this is to remove the spring and see that the piston will drop freely to the bottom of the cylinder when released from any point of its travel. You can make a further test by putting the spring in place and the indicator upon the connecting pipes, with a paper on the drum. Now push the piston down to the bottom of the cylinder, and release the pressure slowly, and when the pressure is all removed, draw the atmospheric line. Again pull the piston as far up as you can and again let it return to its normal position slowly, and draw the atmospheric line. If it is exactly upon the first line you may be sure it is correct at that point, and you may take it for granted that it will be correct at all other points of its travel.

The marking or pencil point should be fine and smooth, and if a metallic point is used, it should not be too sharp, thus avoiding cutting the paper. Do not allow the paper drum to run all the time, but stop it as soon as the diagram is taken. This can be done either by unhooking the driving cord, or by the stop motion with which many of the indicators are supplied.

You must be careful in the selection of the spring used; usually each indicator has instructions with it as to the different spring to use for different pressures. It may be taken as a general rule that the spring should be marked at one-half the initial pressure. It is best to use as light a spring as the pressure will allow, thus making the card as large as possible, for the larger the card the greater the defects will be shown. You must also exercise great care to get the drum motion to exactly represent the piston movement. This is difficult to do in high-speed engines. The best test is the length of the card; if it is longer when taken at full speed than when taken at the slowest speed the engine can be run at, then there is something wrong, and you will not get a correct card.

After having blown out the pipes with steam, put on the indicator and attach your cord, adjusting its length so that your card is exactly in the centre of your paper. Now unhook your cord and put on your paper, being sure that it is even at the corners and tight around the drum. You are now ready to take your card. Start up your drum by hooking on your card. Now turn on the steam by opening the cock at the bottom of the indicator;



leave this cock open a few seconds that the instrument may be warmed up, then shut off the steam and draw the atmospheric line; then open the cock and apply the pencil to the drum by pushing it towards the paper and holding it firmly against the stop on the instrument just sufficient time for the engine to make one revolution. You will then have a clean, fine-lined card—the only correct card to measure up the power of the engine from.

Having taken the diagram with our indicator correctly adjusted, and the connection properly made, we now want to know what is the h. p. as shown by the diagram. To find this it is merely necessary to measure the space enclosed by the diagram, and by this means get the mean effective pressure exerted upon the piston throughout its stroke, which this area really represents. This pressure being multiplied by the number of square inches of the piston area gives us the total pounds of force exerted, and as this force is acting through the distance travelled by the piston, we multiply it by the number of feet travelled per minute, and the

product is the number of foot pounds exerted in one minute. This divided by 33,000 is the h. p. of the card.

Having our indicator in perfect order and applying it, as described, to an automatic cut-off engine with the piston tight, and valves well set and tight, we should get such a card as shown, provided the load was such as to give us a cut-off about $\frac{1}{4}$ stroke. You now want to get the h. p. of this card, and to do this you only need to get the area of the space enclosed by the diagram, and as it is of rather a peculiar shape, we go about it in this manner: We erect a set of ordinates, or lines, at right angles, or perpendicular to the base line or the atmospheric line upon the card. Any number of these ordinates will do, and for convenience we usually put up 11 lines, making 10 equal spaces; the smaller the divisions the greater the accuracy. We now take a scale suitable to the spring used in the indicator, that is, a scale with each inch upon it divided into as many equal parts as the spring is intended for; this you will know by a mark upon the base of the spring, such as 16, meaning 16 pounds to the inch, or 40, meaning 40 lbs. to the inch. In this case we used a 40 spring, and consequently we take the 40 scale and proceed to measure the height of the diagram one-half way between each ordinate, or upon the dotted lines of the diagram. The height of the diagram at the first point of measurement is $\frac{1}{4}$ less than 2 inches, and represents 77 lbs.; the next is exactly 2 inches, representing 80 lbs.; 3 inches, 80 lbs.; 4 inches, 57 lbs.; 5 inches, 41½ lbs.; 6 inches, 34½ lbs.; 7 inches, 27 lbs.; 8 inches, 20 lbs.; 9 inches, 16 lbs.; 10 inches, 13 lbs., making a total of 446.

Now, as we have measured 10 spaces, we add them up and divide by 10; this gives us 44.6 lbs., and is the mean effective pressure (M.E.P.) throughout the stroke. This measurement has simply reduced our peculiar-shaped area enclosed by the diagram to a parallelogram the length of the card and of a height equal to 44.6, or $1\frac{1}{4}$ inches high. We know that the work done by the steam is the same as though the pressure was 44½ lbs. from start to finish of the stroke. Assuming that our piston has an area of 100 square inches, and that it travels at the rate of 500 feet per minute, we can very readily arrive at the horse power represented by the card. 100 square inches \times 44.6 lbs. = 4460 lbs.; this, you may say, is 4460 lbs. moments of work. Now, as our piston is travelling 500 feet per minute, we multiply the moments of work by the feet travelled per minute, 4460 \times 500 = 2,230,000; these are the foot pounds of work, and the foot pounds divided by 33,000 is the horse power of the card, $\frac{2,230,000}{33,000} = 67.57$ h.p.

This is the total power exerted by the engine, including its own friction. Should you want to figure the water consumption from the diagram, it would be necessary to know the clearance of the engine—that is, the space between the piston and the valves—when the engine is on dead centre, and erect an ordinate at each end of the card, far enough away to represent the percentage of the clearance to the total piston displacement; but for simply measuring the h. p., or finding the M.E.P., this knowledge is not necessary. You will see at the lower left hand corner a curve marked G. & K.; this is the compression curve and represents that the exhaust valve closed at the point G., or about 3 inches before the stroke was completed. Our engine during this travel was compressing any small amount of air still remaining in the cylinder, and by the time the piston reached the end of the stroke the pressure reached the point K., or a pressure of about 28 lbs. This occurred before the steam valve opened to admit steam to move the piston in the opposite direction. Compression is useful for several reasons—one is that it decreases the knock when the motion of piston across head is reversed by gradually taking up any slack there may be, and another is that it fills the clearance spaces with steam compressed up to nearer the boiler pressure, and starts to re-heat the surface of piston and cylinder walls. If you should have a back pressure your diagram would show the atmospheric line, marked A, to be lower than the diagram, and it can be measured by the scale the same as the pressure, and should be deducted from the h. p. of the card.

A new 75 horse power boiler has been placed in the electric light station at Digby, N.S.

The Fern Mine, Hall Siding, in the Rossland district, B.C., are lighting up the mill and yards, as well as the tunnel of the mine, by electricity, and have placed the order for machinery and apparatus with the Royal Electric Co.

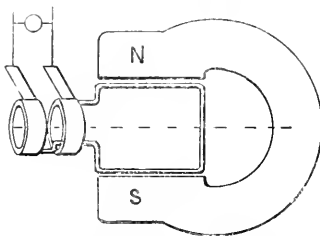
* Paper read before Toronto Association C.A.S.E., Nov. 17th, 1897.

DIRECT AND ALTERNATING CURRENTS.*

BY E. H. LEONARD.

You are all aware that direct or continuous currents are so called from the quality which they possess of maintaining a uniformity of direction of flow with regard to the conductor through which they are passing. Direct currents, however, are not always of constant pressure; but are often intermittent or pulsatory in their character, and under such conditions exhibit many of the characteristics of alternating currents, which are constantly fluctuating with more or less rapidity from a positive value to the opposite or negative value many times in a second, the frequency of commercial alternators varying from 25 to 140 complete periods or cycles per second.

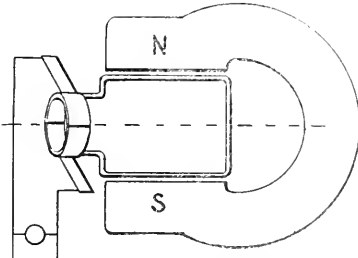
I shall not attempt in the short space of time you have to listen to me to-night to skim over the whole field, but will confine my remarks more particularly to the kind of electric currents the steam engineer is more apt to come in contact with. The rapid strides that electricity is taking makes it important that all should familiarize themselves with the laws governing this subtle force. Most any of you are liable to be placed in a position where you will have charge of one or more dynamos for generating electric



ALTERNATING CURRENT DYNAMO.

current for lighting or power purposes, and it is to dynamo electric current that I shall more particularly refer to-night. I assume that you are aware that metallic substances are good conductors, copper being the best commercially; also that most other substances are poor conductors, some being such poor conductors as to be termed insulators, such as glass, porcelain, dry wood, paper and cloth. The great Faraday, who may well be called the father of the electric dynamo, discovered in 1831 that when a coil of wire was made to approach a magnet, an electric current was momentarily established in the coil, as indicated by the deflection of a galvanometer connected in circuit with the coil. This discovery was followed by a series of experiments probably unequalled in any branch of scientific research for brilliancy of perception and clearness of reasoning power. This philosopher, before his death, gave to the world the fundamental principles upon which the dynamos of to-day are constructed.

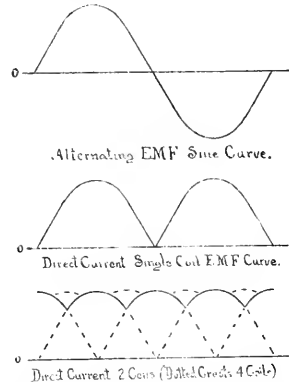
Starting with Faraday's principle of induction, let us construct a very simple form of dynamo. Take an ordinary horse-shoe magnet, and for simplicity I will show a single turn of wire arranged to revolve in the magnetic field; if to the two ends of this coil of wire we attach a pair of rings, and on them place two



SINGLE COIL DIRECT DYNAMO.

strips of thin sheet copper for brushes to conduct the current to the outside circuit, we have all that is essential for our dynamo. If in the circuit of this elementary dynamo we place a galvanometer—which is an instrument for indicating the flow of electric currents—we shall find that as we turn the coil about there will be a deflection of the pointer of our instrument, first in one direction, then in the opposite, as the coil in our dynamo assumes first

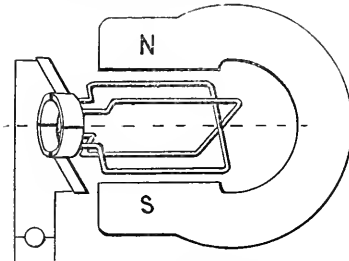
one, then the other position with regard to the magnet. We have produced then an alternating current. If we wish to obtain direct currents, we must change our construction, and substitute in place of our two rings a commutator, which in its simplest form consists of two sections. We will split a piece of tube in two, and mount it on the spindle in place of the rings, connecting one end of our wire to one part, the other end to the other part, insulating the two parts from each other, so there will be no electrical connection between them. Again we rotate the coil, and we shall find the galvanometer deflection takes place always in the same



direction, but comes to zero at each half revolution of the coil. We can represent by a curve just what takes place in the coils or armatures of these two forms of dynamos during the period of one complete revolution. Just as the steam engine indicator represents the pressure at every part of the stroke, so our curve will show the electro-motive force at every point of the revolution.

The E.M.F. (electro-motive force) curve of our alternating dynamo, starting from a line of zero potential, will rise more or less abruptly, depending upon the design of the dynamo to a point of maximum positive potential, then drop, and passing the neutral or zero potential line, descends to the point of maximum negative potential.

The most desirable form of all-round work, and the one which most modern, well-designed alternators follow, is the sign curve, though many single phase alternators, which are perfectly satis-



TWO COIL DIRECT CURRENT DYNAMO.

factory for lighting purposes, depart considerably from this form and show a peak-topped, and some a flat-topped curve. The E. M.F. curve of our direct current dynamo differs from the alternator for the reason that the commutator replacing the collector rings slips from under one brush to a position under the opposite brush, just at the moment the current in the coil is about to reverse, and instead of descending below the zero line, it again ascends, making in a complete revolution two curves, similar to the first half of our alternating current curve, both of which are above the zero line. Such a curve represents a series of impulses following each other with every half revolution, and would not make a satisfactory current for practical working. Other evils would also creep in, as we multiplied the number of turns to obtain the commercial voltages, which would produce vicious and destructive sparking at the commutator.

To obtain a commercial dynamo for direct currents we must then alter our design, and instead of using a large number of turns of wire in a single coil, we must divide these turns into a number of smaller coils, and furnish segments in our commutator to correspond with the increase in number of coils. We will first

* Paper read before Toronto No. 1, Canadian Association of Stationary Engineers.

see the effect of two coils spaced equally around the periphery of our armature with a segment attached to each end of the coils.

Now, if we trace an electro-motive force curve from this armature, we shall find that the pressure does not fluctuate so much as with the former arrangement, and instead of dropping to zero at each half revolution, the pressure is always maintained at a point of considerable pressure, for the reason that soon after a coil has passed into a position in the field where the rate of cutting lines of force is less, the commutator sections corresponding to this coil have slipped from under the brushes, and the sections connected to the other coil have passed under and into contact with the brushes, and supplies the circuit with a fresh E.M.F. rising in potential; the other coil in the meantime is out of circuit or idle. If, instead of two coils we employ a still larger number, we continue the process of smoothing out till we finally get a practically constant pressure throughout the revolution. Also, as we multiply the coils we shall find it desirable to avail ourselves of the E.M.F. generated in the coils, which are not in a position of maximum potential, and utilize the potential of coils rising to maximum and descending to zero; this will also materially reduce the sparking at the commutator. Thus, all the coils in a commercial dynamo are connected together and loops taken to the segments of the commutator, except in a few cases, notably the Brush dynamo.

So far the dynamos we have been considering have been constructed without iron in the armatures, but as iron is a much better conductor of the magnetic lines of force, which are depended upon to induce the E.M.F. in our coils, it would evidently be better to introduce an iron core into the structure, thus reducing the reluctance of the magnetic circuit. Also, we have used a permanent horse-shoe magnet, whereas we can obtain a much more dense and powerful magnetic field by using an electro magnet, which may be obtained by passing the electric current through a coil of wire surrounding an iron core. The shorter and thicker we can make the magnetic circuit, the less energy there will be required to produce the magnetic field, and wide air spaces are to be avoided, as they offer serious resistance to the flow of lines of force through the magnetic circuit. Part of the electric current generated by the dynamo itself is generally utilized to excite the field of direct current dynamos, though alternators are usually separately excited by a smaller direct current dynamo. What applies to the magnetic circuit in a direct current dynamo is equally true in regard to an alternating current dynamo. Care must, of course, be taken to insulate the copper of the electric circuit from the metal which is used for the magnetic circuit, as well as to insulate the various turns or convolution of the electric circuit from each other, so as to avoid short circuits.

From what has been said, I trust you have been able to form a fair idea of the manner of obtaining both alternating and direct currents by means of the dynamo electric machine, which is only a piece of apparatus for transforming the mechanical energy of the water-wheel or steam engine into electrical energy. There are several types of direct current machines, but they can be divided into two principal classes—constant current dynamos and constant potential dynamos. The constant current dynamo is used principally for arc lighting, the flow of the current remaining fixed while the E.M.F. increases as the arc lamps or other devices are added in series. The constant potential dynamo is the type generally used for incandescent lighting and power purposes. This type of dynamo is designed to maintain a constant E.M.F. or pressure, and the current is increased as lamps or motors are added to the circuit in multiple. Alternators are also built for constant current and constant potential, though the former are not much used at present.

Direct currents are generally used at low E.M.F., 110 to 125 volts being common for lighting plants, though in arc dynamos the pressure in the larger sizes reaches as high as 8,000 volts. At 110 to 125 volts, of course, large conductors would be necessary to supply any considerable amount of energy, which necessarily confines this type of dynamo to limited areas, so the work can be reached without too large an expenditure for copper conductors. The alternating currents, however, on account of the facility with which they can be transformed from a high to a low voltage, or vice versa, without the necessity of any moving parts in the transformers or converters, as such devices are called, are generally used for transmitting energy to greater distances, and for distribution covering areas of many miles. The Niagara power is transmitted 26 miles to Buffalo by alternating currents generated by 5,000 h. p. two phase alternators at 2,000 volts, transformed to three phase alternating currents at 10,000 volts for the transmission, and at Buffalo transformed from 10,000 to about 340 volts alternating, which is then transformed by rotary transformers into direct current at about 550 volts for supplying the street railway motors. As can be seen from this instance, the flexibility of the alternating current system is wonderful, particularly when it is understood that these transformations take place in the static transformers with a loss of less than 2 per cent. for each change, the greatest loss for any change being in the rotary transformer, and even this is obtained at an expense of about 5 per cent. Under the high pressure alternating currents are transmitted with allowable loss and transformed to the lower and safer pressures on the spot where the current is to be utilized. It is difficult in so short a space to give much of an idea of either direct or alternating currents, not to mention their differences, but I have tried to touch on a few points, which I hope will awaken sufficient interest to bring about a deeper study of the subject.

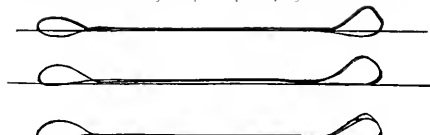
QUESTIONS AND ANSWERS.

IN the October issue of the NEWS, "Indicator" stated that he was thinking of putting an indicator on his engine, an Armstrong & Sims, with 12 inch stroke, and asked to be given the sizes for the correct rigging, and instructions as to how to set it up. In reply thereto, a correspondent sends the following, accompanied by a number of cards, some of which we reproduce:

SIR,—In answer to "Indicator," although only an amateur at this work, yet I think my rigging correct. It is as follows: First, a plate $2\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$, with a slot in centre $2\frac{1}{2}$ deep $\times \frac{1}{2}$, is screwed on to crosshead, then a standard screwed on to crosshead guide

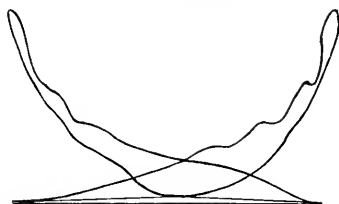


Exhaust Card.—Engine $9\frac{1}{2} \times 12$ in., 80 lbs. steam, 10 lbs. spring, 250 rev.; No. 10 dynamo, 60 amp. load, 113 volts.

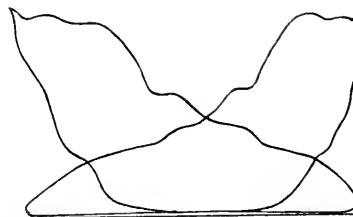


Exhaust Card.—Engine $9\frac{1}{2} \times 12$ in., 80 lbs. steam, 10 lbs. spring, 285 rev.; 10 amp. load, 113 volts.

either by a hollow bolt or the oil cup itself. The lever is supported from this standard by a pin and held in place by a nut. At the bottom end of the lever there is a $\frac{1}{2}$ pin to work in the slot in the crosshead plate, with the pin a little long so that it will have no tendency to come out of slot. My lever is $20 \times \frac{3}{4} \times \frac{1}{2}$, and from centre to centre of pins is $18\frac{1}{2}$ long, equals 12 times the length of stroke. My cord is attached to a pin $\frac{1}{2}$ from top pin; instead of a cord, which I found stretched, I use a fine wire. At the end of crosshead guide I have a standard, with leading pulley attached, so as to take off my cord equal on both ends of stroke. If I am wrong at any point, I will be glad if those who know better will show the fault. The accompanying cards were taken by this rigging, and I would like to have a discussion on them. I make no remarks on them myself, as I cannot fully read them all, but perhaps some of your readers will be willing to take the trouble to do so. The exhaust cards were taken off the $9\frac{1}{2} \times 12$ engine by a connection at the drain pipes through to the exhaust about $12\frac{1}{2}$ below cylinder. I inserted into the exhaust a piece of $\frac{1}{2}$ pipe $3\frac{1}{2}$ long, the top half of pipe cut off so that it formed a channel



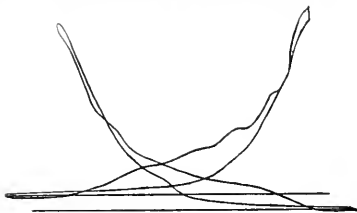
Centre T Connection.—Engine $9\frac{1}{2} \times 12$ in., 80 lbs. steam, 40 lbs. spring, 292 rev.; No. 10 dynamo, no load.



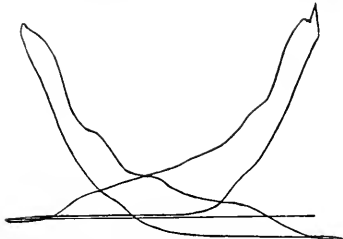
Centre T Connection.—Engine $9\frac{1}{2} \times 12$ in., 80 lbs. steam, 40 lbs. spring, 255 rev.; 185 amp. load, 113 volts.

for the steam to flow to the indicator. That it formed no back pressure can be seen by the cards off the cylinder, which were taken after I inserted this exhaust pipe. From the exhaust to indicator, pipe was $18\frac{1}{2}$ long. My cord from reducing lever was led over the leading pulley as for other cards. To let out any water, I put a cock on right at indicator, so that nothing lay there to distort card. The cord I used then stretched a little, so they are about $\frac{1}{2}$ too long. The direct connection cards were taken when there was only indicator cock and couple and nipple between cylinder and indicator. I had, of course, to change indicator to each end each time, but as I had a steady lead it did not matter. I moved the paper purposely on the barrel each time. In each case the head end is at the left hand side and the crank end at right. The centre T connection was arranged with a globe valve at each end and indicator in centre. I could have sent more cards of this, but those sent will show how much out

this arrangement was. The 12"x12" engine is also an Armington & Sims, but had had considerable tinkering at it before we got it. The crank-pin runs almost hot nearly all the time, and we dare not key it up as it ought to be, and as a consequence she pounds the whole time. We have had the expert man of our village at it, and men from three different shops of our neighbor-

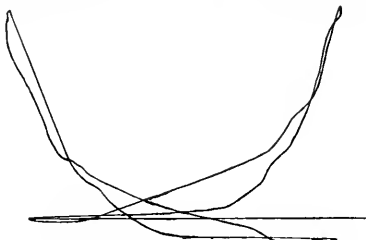


Straight Connection.—Engine, $9\frac{1}{2} \times 12$ in., 80 lbs. steam, 40 lbs. spring, 212 rev.; No. 10 dynamo, no load.

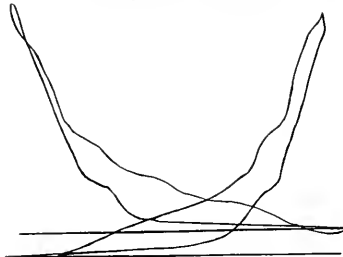


Straight Connection.—Engine, $9\frac{1}{2} \times 12$ in., 80 lbs. steam, 40 lbs. spring, 289 rev.; No. 10 dynamo, 85 amp. load, 110 volts.

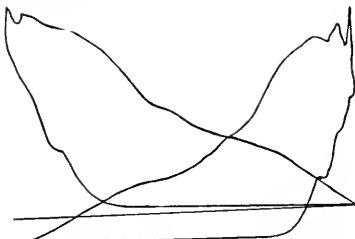
ing town, but nothing could be done, and thus it has been for two years. These cards I have taken just for my own enlightenment, and I trust they show up the trouble. Do they? The cards I would like most to be figured out are the exhaust, straight con-



Direct Connection.—Engine 12×12 in., 80 lbs. steam, 40 lbs. spring, 262 rev.; 2 No. 10 dynamos, friction load only.



Direct Connection.—Engine 12×12 in., 80 lbs. steam, 40 lbs. spring, 263 rev.; 2 No. 10 dynamos, 50 amp. load, 113 volts.



Direct Connection.—Engine 12×12 in., 75 to 80 lbs. steam, 40 lbs. spring, 55 rev.; 2 No. 10 dynamos, 320 amp. load, 113 volts.

nection and direct connection. Of course, if any one would go into more of them, I think it would be generally appreciated. Would there be any advantage in carrying a higher or lower pressure for the different loads?

"AMATEUR."

MR. Wm. Thompson sends the following answers in reply to questions asked in our November number:

"Ontario": Point of cut-off will vary in direct proportion to the load within reasonable limits. Under ordinary conditions, your engine at 80 lbs. gauge pressure, with a load of 25,000 watts, will have a ratio of expansion of about 4. It is not economy, in a single cylinder of this type, to expand more than 4 times. When load is reduced down to 6,250 watts, cut-off must take place considerably earlier in the stroke, with a corresponding increase in number of expansions. While engine is running underloaded, it would be economy to reduce steam pressure as suggested, so that point of cut-off will be about $\frac{1}{4}$ -stroke. This, however, can only be carried out within reasonable limits, and much depends on style and condition of engine. "Ontario" must bear in mind that the same degree of efficiency cannot be obtained while running "underloaded" in comparison with "normal" load.

"Subscriber": Chimneys are required for a two-fold purpose, 1st, to carry off obnoxious gases; 2nd, to create draft. The first requires area, the second height. The intensity of the draft varies in direct proportion with the difference between external and internal temperatures, and any reduction in the temperature of the internal gases, with the temperature of external air remaining constant, directly affects the intensity of the draft. I would refer "Subscriber" to the report of a test made on the boilers of the Armour Packing Company at Kansas, to determine the saving effected by the use of "Green's Economizers," and published in Power for July or August last. In this report "Subscriber" will observe very clearly that as temperature of flue gases decreased readings of draft gauge also decreased, as well as combustion of fuel per square foot of grate surface per hour. The fact that "Green's Economizers" can be used with natural draft is due to many causes, chiefly to two: 1st, draft previous to installation of economizer was sufficiently good; 2nd, use of economizer may effect a saving in fuel ranging from 1 to 50 per cent., and required combustion of fuel per square foot of grate surface per hour is correspondingly less. The life of pipes would depend upon four things: 1st, quality of material and workmanship; 2nd, circulation and corrosive action of water on inner face of pipes; 3rd, depositing of scale forming materials from the water; 4th, action of corrosive acids generated from the fuel (such as sulphurous, sulphuric and nitric acids). A given quantity of heat is required to heat a given quantity of water to a given temperature. This is the same whether heat is applied by fuel or steam. I consider heating feed water with live steam a loss, and should only be used where no better method can be had, and then only because it prevents undue expansion and contraction of boiler plates and fittings due to cold water being pumped into the boiler.

"Subscriber" writes: I had been using two boilers, but the manager decided to operate one only, on the ground of economy. The small boiler is 8×13 , and the large boiler now used 6×16 , rated at 120 h.p. It is being forced to do the work of the two. The engine is 150 h.p., and there is a $1\frac{1}{2}$ -inch pipe running from boiler through the shop to dry lumber. Shavings are used for fuel. Do you think we are effecting a saving by using only one boiler?

ANSWER.—"Subscriber" does not say what power the 150 h.p. engine actually develops. If steam required for engine and drying purposes requires single boiler to be forced, there is certainly no economy in using only one boiler. Forcing a boiler past its capacity is extremely hazardous, and liable to lead to serious results. It is also a wasteful practice, as process of combustion cannot be carried out properly when fires have to be forced. If consumer could give quantity of water required to be evaporated hourly a very much clearer opinion could be offered.

"N.S." writes: Will you kindly let me know how storage batteries are charged. Can they be charged from an alternating current?

ANSWER.—Storage batteries cannot be charged by an alternating current; if, however, the current supplied by an alternating generator be rectified in any way, then it can be used to charge them. Storage batteries are charged by being connected across the mains of an ordinary direct current source of supply, like a lamp or other load, and left in circuit until the instruments used with them indicate that they are charged. Batteries are not apparatus that an inexperienced man should play with; they are rather expensive, delicate, and apt to get out of order if not very carefully charged and discharged. If properly cared for, they can, in certain conditions, be a valuable auxiliary to a plant.

Proposals for the construction of electric railways in the city of St. Petersburg are being considered. There will be eight miles of these tramways, with four central stations and a number of side stations. Fares will be about two cents first class and about one cent second class. The promoters of the railroads have asked for a concession for forty years, giving the city the option to purchase after twenty years.

At the present session of the Ontario Legislature the following companies will seek incorporation to build electric railways: Bothwell & Florence Electric Railway Company; Chatham City & Suburban Railway Company; Toronto and York Railway Company; Smith's Falls, Rideau & Southern Electric Railway Company; Seine River, Foby and Fort Frances Railway Company; and Sandwich, Windsor and Amherstburg Railway Company. The Hamilton and Dundas Street Railway Company, the Kingston, Portsmouth and Cataragui Electric Railway Company, and the Toronto and Scarboro' Electric Railway, Light & Power Company will seek amendments to their charters.

WEBSTER SYSTEM OF STEAM HEATING.

REFERRING to the discussion on exhaust steam heating which has recently appeared in our "Questions and Answers" department, Messrs. Darling Brothers, Montreal, Canadian representatives of the Webster patent system of exhaust steam heating, write as follows:

"When the Webster system was first introduced in Canada and the United States, steamfitters would bid upon a gravity system and then add cost of the Webster system, resulting in a prohibitive figure for the work in most cases. After some experience they now estimate the cost of a gravity system and offer to install the Webster system at the same figure, and in some instances for less money. We offer the Webster system entirely on its merits and economies, claiming it well worth the price, when compared with systems offering no similar advantages. In fuel economies alone we have the most accurate data, taken from indicator cards, where the engineer was entirely impartial, showing that a back pressure of ten pounds on the engines caused a loss of fuel equal to 29%, and an efficiency equal to that percentage resulted from the application of the Webster system. The extent to which we can reduce pipe and valve sizes, the discarding of all forms of air valves, the less labor required, are incidental only, and permit the installation of the Webster system at a cost not exceeding a first-class gravity system."

PRESENTATION TO MR. JAMES MILNE.

FOR several years Mr. James Milne has been connected with the Terauley street electric light station in Toronto, formerly as superintendent for the Incandescent Light Company, and since its amalgamation with the Toronto Electric Light Company, as superintendent for the latter company. A few weeks ago it was announced that he had resolved to sever his connection with the company to assume the management of the Weeks-Eldred Company, general contractors and manufacturers of the Jones underfeed mechanical stoker. General regret was expressed among the employees, and as a token of their appreciation Mr. Milne was presented with an illuminated address, accompanied by a marble clock. Mr. Henry Amos, foreman of the meter department, made the presentation. The address, which was signed by over thirty employees, was as follows:

TO JAMES MILNE, ESQ.

DEAR SIR,—We, the employees of the Incandescent Electric Light Co., have learned with regret that you are about to leave us and sever your connection with the company. We take this opportunity to place on record our appreciation of your straightforward and manly treatment of us, and of your distinguished abilities displayed in the discharge of the duties of the office of superintendent of the company for the past five years. As a small mark of the esteem in which you are held by us, we beg to present you with this marble clock, and although its intrinsic value is not much, it will serve to keep us in remembrance.

We wish you complete success in your new position, and for Mrs. Milne, yourself and family, LONG LIFE AND PROSPERITY.

[Signed] HENRY AMOS J. G. GROUCHER
CHAS. MOSELEY WILLIAM GODDARD
ALEX. RUTHERFORD W. PIKE, &c.

Mr. Milne replied in a happy speech, referring to the harmony that had always existed between the employees and himself. Mr. J. G. Croucher and others followed, emphasizing the kindly sentiments expressed concerning Mr. Milne in the formal address.

Mr. Milne takes to his new position ability of high order, coupled with a full stock of energy. When to these is added the advantage of a valuable training and experience in engineering, it will be apparent that in his present position he is likely to prove himself to be the right man in the right place.

INEFFICIENCY OF STEAM PUMPS.

TORONTO, Nov. 23, 1897.

To the Editor of the CANADIAN ELECTRICAL NEWS.

DEAR SIR, No economy should be too small to receive the attention of a careful manager. I recently heard of one which I commend to all. Steam pumps for boiler feeding, I claim, are a very inefficient apparatus, and could be replaced by either power pumps operated off the shafting, or by others actuated by an electric motor. In either case the power consumed in the mere forcing of water against the boiler pressure would be a very inappreciable item, whereas if the quantity of steam consumed by a steam pump could be measured, it would be found quite considerable. It is seldom, if ever, required to pump while getting up steam, and indeed it might always be arranged to pump the boiler full after shutting down; the actual annual saving in coal consumed would be found to be considerably more than pay interest on the cost of the apparatus, whether a power or steam pump were used.

I would be pleased to learn the views of others interested in the subject.

Yours truly,

"ENGINEER."

TRADE NOTES.

The Royal Electric Co. is shipping the Hamilton Electric Light & Power Co. one of their single phase 2000 light alternators, with station apparatus, etc.

The W. A. Johnson Electric Company, Toronto, have removed from York street to 134 King street west, where they have more commodious and convenient offices and warerooms. This company are representatives of the celebrated Wagner transformers.

Roberval, Que., is to have an electric light plant. Mr. B. A. Scott, who has the matter in charge, has placed an order for the Crocker special turbines with the Jencks Machine Co., of Sherbrooke, Que., to be delivered in ten days.

The Canadian Cotton Mills, of Milltown, N.B., have closed a contract with the Royal Electric Co. for one of their 30 k.w. "S.K.C." two phase dynamos, wound to deliver 110 volts to the service mains. Within the last eight weeks this is the third large manufacturing establishment to install one of these machines of the Royal Electric Co.'s make, the Penman Mfg. Co., of Paris, and the Cockshutt Plow Co., of Brantford, being the other two.

Mr. J. H. Walker, who for many years was manager of the Canadian Rubber Company's Toronto branch, has recently severed his connection with the company and established a wholesale agency for rubber goods at No. 88 Bay street, Toronto. Mr. Walker's long and valuable experience in handling this line of goods, coupled with his personal qualifications, will doubtless enable him to make satisfactory business connections and win success in his new venture.

We are advised by the Packard Electric Co., of St. Catharines, Ont., that they have recently imported from England a sand blast frosting machine, which will enable them to produce frosted lamps superior to those which have been previously placed upon the market. The fine frosting produced by this machine absorbs much less of the light than an ordinary frosted lamp. This company are also in a position to do any style of fancy frosting, bringing out letters, monograms and any desired design upon lamps to be used for decorative purposes.

PUBLICATIONS.

"The Elementary Principles of Machine Design" is a valuable little book by J. G. A. Meyer, and published by the Industrial Publishing Company, New York. It treats of the subject in a clear and concise manner, and is well illustrated.

The Power Publishing Company, New York, have favored us with a copy of a very useful and comprehensive book, entitled "Power Catechism." It contains what are claimed to be correct answers to numerous questions covering the main principles of steam engineering and the transmission of power, and should be of special assistance in preparing students for examinations. Profusely illustrated, carefully prepared and neatly printed, a volume of considerable merit is presented.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

THE EDITOR, the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, where problems of mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the same time, it is hoped that pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to

confer with the Editor of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our

readers, however, who, from time to time, contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus

showing that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education, and attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a

careful study of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the beginning and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

1. BASIC PRINCIPLES. Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
2. SURFACE AND CIRCULAR MEASURE. Definition and explanation and practical demonstrations of.
3. GEOMETRICAL AND ALGEBRAICAL MEASUREMENTS. Definitions and explanations of, with practical hints.
4. SQUARE AND CIRCULAR MEASUREMENTS. Definitions and explanations of.
5. SOLID AND CIRCULAR MEASUREMENTS. (Spring and Lever Types)—Principles of, with practical demonstrations.
6. BOILER CONSTRUCTION. Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled with reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

[ARTICLE VIII.]

APPLICATION OF OHM'S LAW.

(Continued.)

IN our last article we dealt with the application of Ohm's law to what may be termed single conductor circuits, where the source of electrical energy may be either a battery or a dynamo, as the case may require. In this article we will briefly illustrate by example the application of Ohm's law to portions of circuits, and also to divided or shunt circuits.

PORTIONS OF CIRCUITS.

All portions of a single circuit must of necessity receive the same current, but the electromotive force, or what is usually styled difference of potential, or drop in potential, and resistance, may vary to any extent in different sections of the circuit.

Example (4): A generator maintains a constant E M F of 110 volts between its terminals. The terminals are connected to and current is passed through a series of four coils, one having a resistance of 50 ohms, one 25 ohms, one 12.5 ohms, and one 6.25. Paying no attention to the resistance of the conductors between these coils, what is the E M F between the terminals of each coil?

A solution of this problem can best be reached by application of principle laid down in rule 3, viz.: That the electromotive force varies directly with the resistance and with the current.

In this case we wish to find E M F at given points on the line, when R alone of coil is known. The total R of the four coils is 93.75 ohms; calling the coils 1, 2, 3, and 4, and the difference of potential at their terminals E^1 , E^2 , E^3 , E^4 , we get the proportion.

$$\begin{array}{rcl} \text{As} & 50 & E^1 \\ 93.75 : 25 & :: 110 \text{ volts} : E^2 \\ & 12.5 & E^3 \\ & 6.25 & E^4 \end{array}$$

Then working out the problem by regular rules of proportion, we get

$$\begin{array}{l} \text{E M F of } E^1 = 58.7 \text{ volts.} \\ \text{E M F of } E^2 = 29.3 \text{ " } \\ \text{E M F of } E^3 = 14.7 \text{ " } \\ \text{E M F of } E^4 = 7.3 \text{ " } \end{array}$$

An examination of the problem will also prove to the student the theory of the statement that all portions of a single circuit must receive the same current. Taking, for example, total resistance of line at 93.75 ohms, and E M F at terminals of generator at 110 volts, and applying rule No. 1, we get

$$C = \frac{E}{R} \text{ or } \frac{110}{93.75} = 1.17 \text{ amperes.}$$

Applying the same principles to the coils, E^1 , E^2 , E^3 and E^4 , we find that current at terminals of each is the same.

Example (5): Suppose the same external circuit was connected to a generator having a resistance of 10 ohms. The E M F of the 50 ohm coil has been found to be 60 volts, what is the E M F at the terminals of the generator, and what would be the E M F of the generator on open circuit.

The total R of our coils has been found to be 93.75 ohms, and by rule 3 we demonstrate that, as the resistance of the coil is to the total R of the circuit, so is the E M F at the terminals of the coil to the E M F at the terminals of the generator,

$$\text{Or,} \quad \frac{50}{93.75} :: 60 : x, \quad \text{and } \therefore x = 112.5 \text{ E M F at terminals of generator.}$$

By following rule 1, we find the current at the terminals of coil No. 1 to be

$$\frac{60}{50} = 1.2 \text{ amperes.}$$

The total resistance of the circuit is the internal resistance of the generator = 10 ohms; the resistance of the conductors, of which no account has been taken, and the resistance of the four coils = 93.75 ohms.

$$10 + 93.75 = 103.75 \text{ ohms, total R of line.}$$

Then to find required E M F of generator to maintain a current of 1.2 amperes through a resistance of 103.75 ohms, we must apply rule 2.

$$E = R C,$$

$$\text{or } 1.2 \times 103.75 = 124.5 \text{ volts, required E M F of generator.}$$

STRENGTH OF BOILERS.

Having determined the strength of the boiler at the joints, we next require to determine safe working pressure, thickness of plate, tensile strength per sectional inch, etc.

A standard boiler is said to be 42 inches in diameter and have a safe working pressure of 100 pounds per square inch, if constructed in best manner of iron plate one-quarter inch thick, having a tensile strength of 48,000 pounds per sq. inch of section.

From this, then, we can construct the following formula to determine the safe working pressure of any boiler:

$$\frac{TS \times 2T \times \% \text{ strength of joint}}{D \times FS} = P,$$

and from this we require but a slight transposition to construct a formula to determine either the diameter or thickness of plate required to conform to this standard, and

$$\begin{array}{l} \frac{D \times P \times FS}{TS \times \%} = 2T \div 2 = T, \text{ and} \\ \frac{TS \times 2T \times \%}{P \times FS} = D. \end{array}$$

This formula refers to any boiler, no matter whether constructed of iron or steel, 48,000 pounds being taken as the tensile strength for iron, and 60,000 pounds being taken as the tensile strength for steel, and four being taken as a factor of safety in each case when boiler is constructed in best manner.

Example (1): Find the safe working pressure of an iron boiler, made in best manner, joints having a sectional strength equivalent to 70% of solid plate; boiler being 42 inches in diameter and having plate $\frac{3}{8}$ of an inch thick.

$$\frac{TS \times 2T \times \%}{D \times FS} = P = \frac{48,000 \times .75 \times .70}{42 \times 4} = 150 \text{ pounds, safe working pressure.}$$

Same boiler in steel would become:

$$\frac{60,000 \times .75 \times .70}{42 \times 4} = 187.5 \text{ pounds per square inch safe working pressure for steel.}$$

Example (2): Find the required thickness of plate (steel) required in a boiler five feet in diameter, to carry a safe working pressure of 100 pounds to the square inch, sectional strength of a triple riveted joint being 70% of strength of solid plate.

$$\begin{array}{l} \frac{D \times P \times FS}{TS \times \%} = 2T, \\ \frac{60'' \times 100 \times 4}{60,000 \times .70} = 2T = \\ \frac{24,000}{42,000} = .571 \div 2 = .285 \text{ inches, or nearly } \frac{1}{4} \text{ inch, required thickness of plate.} \end{array}$$

Example: What diameter should a boiler be when constructed of iron made in best manner and with $\frac{1}{2}$ inch plates, working

pressure to be 200 pounds per square inch, joints and rivet sections having a tensile strength equal to .70% of strength of solid plate,

$$\frac{T \times S \times 2T}{P \times FS} \times \frac{\%}{100} = D = \frac{48,000 \times 1 \times .70}{200 \times 4} = \frac{33,600}{800} = 42 \text{ inches.}$$

Same boiler constructed in steel:

$$\frac{60,000 \times 1 \times .70}{200 \times 4} = \frac{42,000}{800} = 52.5 \text{ inches.}$$

Example: Find the strain per sectional inch on a boiler 42 inches in diameter, having $\frac{3}{8}$ inch plate and having a working pressure of 100 pounds per square inch.

Formula:

$$TS = \frac{P \times D}{2T} = \frac{100 \times 42}{.5} = 8400 \text{ pounds strain per sectional inch of plate.}$$

STEEL FURNACES AND FLUES.

The Canada Steamboat Act provides that the external working pressure to be allowed on plane circular steel furnaces and flues when subjected to such pressure, when the longitudinal joints are welded or made with a butt strap, shall be determined by the following formula: $90,000 \times$ the square of thickness of plate in inches \div (length in feet $+ 1$) \times diameter in inches equals the working pressure per square inch, provided it does not exceed that found by the following formula:

$$\frac{8,000 \times T''}{D'}$$

T'' thickness in inches.

D' diameter in inches.

The length to be measured between the rings, if the furnace is made with rings.

Example: Find the working pressure of a circular flue 36 inches in diameter, 6 feet long and made of $\frac{3}{8}$ inch steel plate.

$$\frac{90,000 \times \frac{3}{8}^2}{(6+1) \times 36} = \frac{90,000 \times .1406}{7 \times 36} = \frac{12654}{252} = 50 \text{ pounds working pressure.}$$

$$\text{Check: } \frac{8,000 \times T''}{D'} = \frac{8,000 \times .375}{36} = 83.3 \text{ lbs.}$$

The collapsing pressure of a plane circular furnace tube is found by the following formula:

$$\frac{806,300 \times T^2}{D \times L}$$

When T equals thickness of plate in inches.

D equals diameter of flue in inches.

L equals length of flue in feet.

Example: What is the collapsing pressure of a furnace tube whose diameter is 36 inches, length 6 feet and thickness of plate $\frac{3}{8}$ inch?

$$\frac{806,300 \times .1406}{36 \times 6} = \frac{113,365.78}{216} = 524.84.$$

CORRUGATED STEEL FURNACES AND FLUES.

Steel flue furnaces, when new, corrugated and machine made, and practically true circles, the working pressure is found by the following formula, provided that the plane parts at the ends do not exceed six inches in length, and the plates are not less than $\frac{5}{16}$ of an inch thick and furnace made in one length.

$$\frac{12,500 \times T''}{D'} = \text{working pressure.}$$

And for corrugated iron furnaces made similarly the following formula can be used:

$$\frac{10,000 \times T''}{D'} = \text{working pressure.}$$

Example: Find the working pressure allowable on a corrugated steel furnace flue 42 inches wide, 7 feet long and $\frac{3}{8}$ thickness of plate,

$$\frac{12,500 \times .375}{42} = 111.6 \text{ pounds.}$$

Find the working pressure allowable on same furnace constructed in iron.

$$\frac{10,000 \times .375}{42} = 89.3 \text{ pounds.}$$

The electric light company at Dartmouth, N. S., have offered to dispose of their plant to the town for \$30,000. By agreement they are bound to give the corporation the first right of purchase. The citizens' committee has reported that the plant is not suited to the requirements of the town, and it is probable that arrangements will be completed with a New York company, represented by C. K. Corsaut, to purchase the plant. This company have in view the development of the water power at Fall River, at an expenditure of \$100,000.

PERSONAL.

Mr. J. B. Kelly, of Blyth, Ont., has accepted the position of manager of the Goderich electric light plant.

Mr. Chas. W. Hagar, formerly manager of the Royal Electric Company, Montreal, has been appointed manager of the Dominion Burglary & Guarantee Company.

Mr. J. F. Richardson, chief electrician of the Canadian Pacific Railway, has just returned from the Yukon, where he surveyed the route for a telegraph line over Chilcoot Pass.

Mr. Shirley Davidson, of Montreal, has accepted a position as electrical engineer in Jamaica. Mr. Davidson was captain of McGill University football team, and is an all-round athlete.

We regret to learn that Mr. F. S. Barnard, manager of the British Columbia Electric Railway Company, is suffering from a broken leg, the result of being thrown from his buggy.

Mr. Peter Patterson, superintendent of the National Tube Works Co., McKeesport, Pa., was recently promoted to the position of consulting engineer. Mr. A. M. Saunders has been appointed superintendent.

Mr. W. L. Bird, of Bracebridge, Ont., at present taking the course in electrical engineering at the Canadian General Electric Company's works in Peterboro', has accepted a position with the Lachine Rapids Hydraulic & Land Co.

Mr. F. B. Brothers, superintendent of construction on the Montreal Street Railway, left a fortnight ago for Jamaica, in connection with the proposed electric railway at Kingston. Mr. Brothers expects to return to Montreal in a short time.

LEGAL DECISIONS.

A CASE of considerable interest was heard at Stratford, Ont., last month, being an action for damages brought by Cyrus Hacking against H. P. Dwight, president of the G.N.W. Telegraph Company. Hacking, who was an operator employed by Messrs. Gladwin & Donaldson, brokers, of Buffalo, wrote the latter firm, who had leased a wire in Western Ontario from the Great North-western Telegraph Company, intimating that they were being overcharged by the G.N.W. Telegraph Company. The letter was shown to President Dwight, who wrote Gladwin & Donaldson to the effect that Hacking's epistle was "a piece of gratuitous impertinence," and that Hacking "was on the black list for some time and was likely to remain there." Hacking complained that Dwight's letter was libellous and claimed damages. The jury returned a verdict for Mr. Dwight, asserting that there was no libel.

The American Society of Mechanical Engineers met in New York this month, and from the number and value of the papers presented the proceedings must have been of more than usual interest. Mr. F. R. Hutton, 12 West Thirty-first street, New York, is secretary of the society.

The annual statement of the Cornwall Street Railway Company, recently issued, showed a total year's business of \$25,282.68, made up as follows: Passenger receipts, \$16,557.35; freight, \$1,661.47; other sources, \$7,063.86. The operating expenses were \$20,172.81, the items being salaries, repairs, fuel, snow sweeping, in surance and sundries. The bond interest was \$2,500, and the account interests \$1,250, leaving a net profit of \$1,359.87. The capital stock of the company is \$150,000, and it has in the treasury \$33,800.



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ELECTRIC RAILWAY DEVELOPMENT.

AN exchange gives some interesting figures relative to the development of electric railways in the United States:

Ten years ago there were only 86 miles of electric railway track in the United States. Now there are over 14,000 miles. In these ten years street railway propulsion has been revolutionized. Horse cars have disappeared entirely from most of the lines and will soon be curiosities, cable lines have probably reached their maximum mileage, while the number of electrically operated cars has grown from 172 to 37,000. These are some of the impressive facts shown by the following table, taken from an article in the Western Electrician, entitled "A Decade of Electric Railway Development:"

	January 1 1888	1897
Total number of operating street railway companies in the United States.....	615	806
Number of street railway systems operated by horses.....	566	167
Number of street railway systems operated by cable.....	18	38
Number of street railway systems operated by steam dummies (not including elevated).....	35	33
Number of street railway systems operated by electricity.....	21	698
Mileage of horse car track.....	5,474	1,010
Mileage of cable track.....	217	515
Mileage of steam dummy track, (not including elevated).....	216	145
Mileage of electric track.....	87	13,580
Total mileage of street car tracks.....	5,993	15,250
Number of horse cars.....	21,736	3,664
Number of cable cars.....	2,777	5,957
Number of steam dummies and cars.....	423	318
Number of electric cars.....	172	37,097
Total number of street cars, all descriptions.....	25,168	47,036

In 1888 the horse car tracks represented over 91 per cent. of the total, and the electric railway tracks a little over 1 per cent. At the commencement of this year the horse car tracks were a little more than 6½ per cent. of the total, while electric railway tracks represented more than 89 per cent. and were still growing. It is important to note, however, that in these ten years of electrical development very little progress has been made in the direction of substituting electric motors for steam locomotives, excepting upon elevated roads.

C. J. Myles, A. J. Nelles, and Mr. Jennings, C.E., recently made a trip over the proposed extension of the Hamilton, Grimsby and Beamsville railway from Beamsville to St. Catharines.

The by-law to guarantee the sum of \$50,000 for the building of an electric railway in St. Thomas, Ont., was carried by the rate-payers on the 30th ultimo by a large majority. Under the agreement the company must build six and one-half miles of track. Mr. J. H. Still is the promoter of the scheme.

Messrs. B. F. Pearson, of Halifax, and Wm. Mackenzie, of Toronto, were in Montreal recently completing arrangements for the construction of the electric railway at Kingston, Jamaica, reference to which was made in the November number of the NEWS. The work of construction is to be pushed on rapidly during the winter months, so that by the next hot spell the inhabitants of the island may enjoy all the delights of rapid locomotion in hot weather, without the discomfort of personal exertion. Among those interested in the Jamaica syndicate are: H. M. Whitney, Boston, Mass.; F. S. Pearson, New York; Jas. Ross, Montreal; William McKenzie, Toronto; W. B. Ross, Q.C., Halifax; R. C. Brown, Halifax; B. F. Pearson, Halifax; R. D. McGibbon, Q. C., Montreal; Granville C. Cunningham and W. B. Chapman, Montreal.

THE LATE MR. ROSS MACKENZIE.

A TELEGRAM from Nelson, B. C., a few days ago, announced the death of Mr. Ross Mackenzie, a gentleman well-known to many readers of this journal. At the time of his death, which is supposed to have resulted from an injury received at Niagara Falls, and for which an operation was performed, he was employed officially by the C. P. R. in connection with the construction of the Crow's Nest Pass railway.

The late Mr. Mackenzie had for years been engaged in railway work. He was a son of Mr. Campbell Mackenzie, of Toronto, and was born in 1857 in the city of New York, but removed to Canada when quite young. In 1873 he entered the service of the Shelden Company in Toronto, and two years later was removed by the company to Hamilton. In 1878 he accepted the



THE LATE MR. ROSS MACKENZIE.

position of book-keeper for the Credit Valley railway, and in 1884, when this railway was merged in the Canadian Pacific railway, he became general superintendent's accountant of the Ontario division. Afterwards he was removed to Montreal, where he remained for several years. Shortly after the completion of the Niagara Falls Park and River Railway, the management thereof was offered to and accepted by Mr. Mackenzie. About one year ago he tendered his resignation, and quite recently accepted a position on the Crows' Nest Pass Railway. Mr. Mackenzie was a member of the Canadian Electrical Association, and served on the executive committee for one year while manager of the Niagara Falls road.

A few years ago Mr. Mackenzie stood in the front rank as an athlete. He was best known as a lacrosse player, being captain of the Toronto lacrosse club early in the eighties, and the holder of the world's record for throwing the ball.

The American Rattan Co. have just completed their new factory and are removing to the town of Walkerton. They have purchased from the Royal Electric Co., for lighting their factory, a complete electric lighting equipment.

SPARKS.

Brockville, Ont., is agitating for a municipal lighting plant.

An electric light plant is being installed at McAdam Junction, N.B.

Noble & Barber, electrical contractors, have started business in Montreal.

The town of Cobourg, Ont., are asking for permission to install an electric light plant.

The city council of Stratford, Ont., will advertise for tenders for the right to build a street railway.

Messrs. Smith & Co. have a contract for lighting the village of Gatineau Point, Ont., by electricity.

Late exports from New York City to Hamburg, in Germany, included large quantities of electrical supplies.

Elias Rogers has put in a dynamo for electric lighting and to operate the crane used in unloading coal vessels.

The Dodge Wood Split Pulley Company, of Toronto, recently received an order from an English firm for 3,900 pulleys.

The Knowlton Electric Light Company, Knowlton, Que., has been dissolved. Austin W. Peters is now sole proprietor.

The Montreal Street Railway Company have re-elected Mr. L. J. Forget president, and Mr. James Ross vice-president.

Two hundred and twenty installations of electric light are said to have been made in Buenos Ayres, Argentine, this year.

The Mayor of Hamilton has been interviewed by a gentleman who submitted a scheme for an electric railway from Hamilton to Caledonia.

Mr. H. J. Beemer is credited with a scheme to purchase the North Shore line of the C.P.R., and have the whole Quebec system electrified.

Mr. Morley Jarvis, of Guelph, and Mr. Page, of St. Marys, have invented an apparatus whereby exhaust steam can be used for different purposes.

The Deschenes Lighting Company have been asked to stretch wires across the river and supply electric light to the villages of Britannia and Birchton, Que.

Mr. St. Germain, of North Toronto, is said to be negotiating for the construction of horseless carriages, to run between York Mills and the C.P.R. crossing.

The Hull Electric Company has purchased the Aylmer branch of the C.P.R., which is at present under lease, the price being in the neighborhood of \$100,000.

The town council of Annapolis, N. S., have voted in favor of purchasing an electric light plant. The question will be submitted to a vote of the ratepayers.

The appeal of the London Street Railway Company against an assessment of \$80,000 on rails, poles and wires was argued a fortnight ago, and judgment reserved.

Swainson & Pierce have commenced business at Wallaceburg, Ont. They will handle electrical goods, such as medical batteries, door bells and burglar alarms.

The Ottawa Street Railway Company have experienced considerable trouble on account of motors being either absolutely destroyed or seriously damaged by water.

A scheme has been mooted to build an electric railway from Bobcaygeon to Peterboro, the cost being estimated at \$200,000. Provincial and Dominion aid will be asked for.

The Kingsville Electric Light & Power Co. have placed an order with the Royal Electric Co. for a 50 light 6½ amp. arc machine, with lamps, for lighting the streets of Kingsville.

Abraham Goodwin and John Kerr, Brantford, have bought out the repair department of the A. R. Williams Co.'s machinery agency there, and will operate it on their own account.

The Dominion Cotton Mills Company have given a contract to the Lachine Rapids Hydraulic & Land Company for the supply of electricity for power purposes for a period of twenty years.

Messrs. Moodie & Son, of Terrebonne, Que., have completed their new factory and are lighting the same throughout with electricity. The order for the electrical apparatus has been placed with the Royal Electric Co., Montreal.

Mr. Treffe Lavigne, foreman in the street railway power house at Ottawa, and who recently ran for alderman in Victoria Ward, is suffering from an electric shock. He was working on one of the machines when he made a short circuit. Immediately the

wires which he was holding became a mass of flame, and his hands got a severe scorching.

The Lachine Rapids Hydraulic & Land Company have made a proposition to the Harbor Commissioners to supply shipping interests with electric power for loading and unloading vessels. The chief engineer has been requested to report on the proposition.

The St. Jerome Electric Light Co., of St. Jerome, Que., have purchased from the Royal Electric Co., and are installing in that town, a 50 k.w. S.K.C. two-phase alternating current dynamo, with Stanley transformers, etc. They expect to start up with 750 lights installed.

An important innovation is being made on the Canadian portion of the Grand Trunk Railway system, in substituting compressed air for steam as a motive power in their shops. It is said to be cheaper than steam, and has been applied successfully in the shops at Toronto, Belleville and other places.

It is rumored that the Sherbrooke Street Railway Company will extend the line to Little Magog Lake next summer. It is also rumored that Messrs. R. N. Arkley & Son will construct a dam on the Magog, below the Little Lake, at a point on Mr. Henneker's estate, to develop supplementary power for the company.

The Folger-Hammond Mines Company has been organized in Toronto, Sir Richard Cartwright being president and Mr. W. H. Carvey secretary. They propose operating near the Saw Bell mine, in north-western Ontario. Tenders will be invited for the supply of electric power from Clearwater Falls, one mile distant.

The Department of Public Works at Ottawa has been advised of the completion of the extension of the government telegraph line along the north shore of the St. Lawrence, from Esquimaux Point to Agwanus, a distance of 80 miles. Offices have been opened for business at Agwanus, Piastro Bay and Sheldrake. The line is now 350 miles from Belle Isle.

The Windsor Electric Light & Power Co., of Windsor, N. S., whose plant was destroyed by the late fire, immediately started to rebuild the same, and have given an order to the Royal Electric Co. for apparatus and transformers, etc., consisting of S. K.C. alternators and Stanley transformers. The ashes of the old station had hardly grown cold before the order for the new apparatus was placed.

Referring to the proposed transmission plant at Goldstream, B.C., Mr. F. S. Barnard, manager of the British Columbia Electric Railway Company, writes as follows: "We have not yet definitely decided upon plans for a transmission plant. I may say, however, that our generating station will have a capacity of about 1,000 h.p., developed by water delivered under a 570 ft. effective head. This power will be transmitted by a voltage of about 10,000 to the substation at the city of Victoria, a distance of about twelve miles, and there distributed for the purpose of running our street cars, arc and incandescent light and power circuits.

The corporation of Fort William is about to erect as complete an electric lighting plant as, perhaps, is in use in any town in Canada. They are installing one 50-light 2,000 c.p. arc dynamo, with 35 double or arc-light lamps for lighting the streets of the town and the C. P. R. yards, and for the incandescent service are installing an S.K.C. alternating current dynamo with a capacity of 1,000 lights, with Stanley transformers throughout. The corporation expects to be in a position to furnish light by the 1st of January next. The entire electrical equipment has been bought from the Royal Electric Co., and the engines and boilers from the Robb Engineering Co., of Amherst, N. S. The station which is now being erected is only temporary, and will likely be changed in the spring when the new waterworks system is installed.

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SPARKS.

The electric light plant at Drayton, Ont., owned by J. L. Pollock, was recently damaged by fire.

The motormen and conductors of the Ottawa Electric Railway have formed a fraternal organization.

The Rosamond Woolen Co. have ordered an \$8,000 boiler and engine from Goldie & McCulloch, of Galt.

Mr. J. E. Jones, of Kingston, Ont., has invented a street car fender, which is said to work very satisfactorily.

The Canadian General Electric Company have in course of construction at Peterboro', Ont., a new power and pump house.

The London Street Railway Company will probably return to the use of coal stoves. It is said that heating by electricity exhausts too much power.

At the Digby, N. S., electric light station recently, the attachment to the governor gave way and a smash-up followed. Engineers Daley and Armstrong received a slight shock.

The St. Jerome Power & Electric Light Company have had such success in canvassing for lights that they have changed their order from a 1,000-light S.K.C. machine to one of 1,500 lights capacity.

The Gravenhurst Electric Light & Power Company have purchased new arc lamps.

The Cascade Water Power and Light Company, composed of Rossland and Spokane capitalists, will build an electric railway in the vicinity of Grand Forks. It will also furnish electric light.

Mr. A. A. Dion, of the Ottawa Electric Company, is delivering a series of lectures on "Electricity" at the Canadian Institute. A large number of students are taking this course at the institute.

Charles R. Hosmer, of Montreal, general manager of the Canadian Pacific Telegraph service, the Postal-Pacific Telegraph Company, and the Commercial Cable Company, has lately returned from the west. He says that within the next year the Canadian government will construct and complete a telegraph line to Dawson City, and by the identical route originally surveyed 30 years ago by George Kennan, the Siberian traveller.

The United States consul at Creffield reports the discovery of what he terms incandescent gas. A single jet of ordinary size can emit light of much more than 1,000 candle power, and fine print can be read at a distance of 100 feet. The inventor says that the cost of a light of 1,500 candle power is only 4½ cents per hour, while that of an ordinary electric light of 400 candle power is 14 cents per hour.

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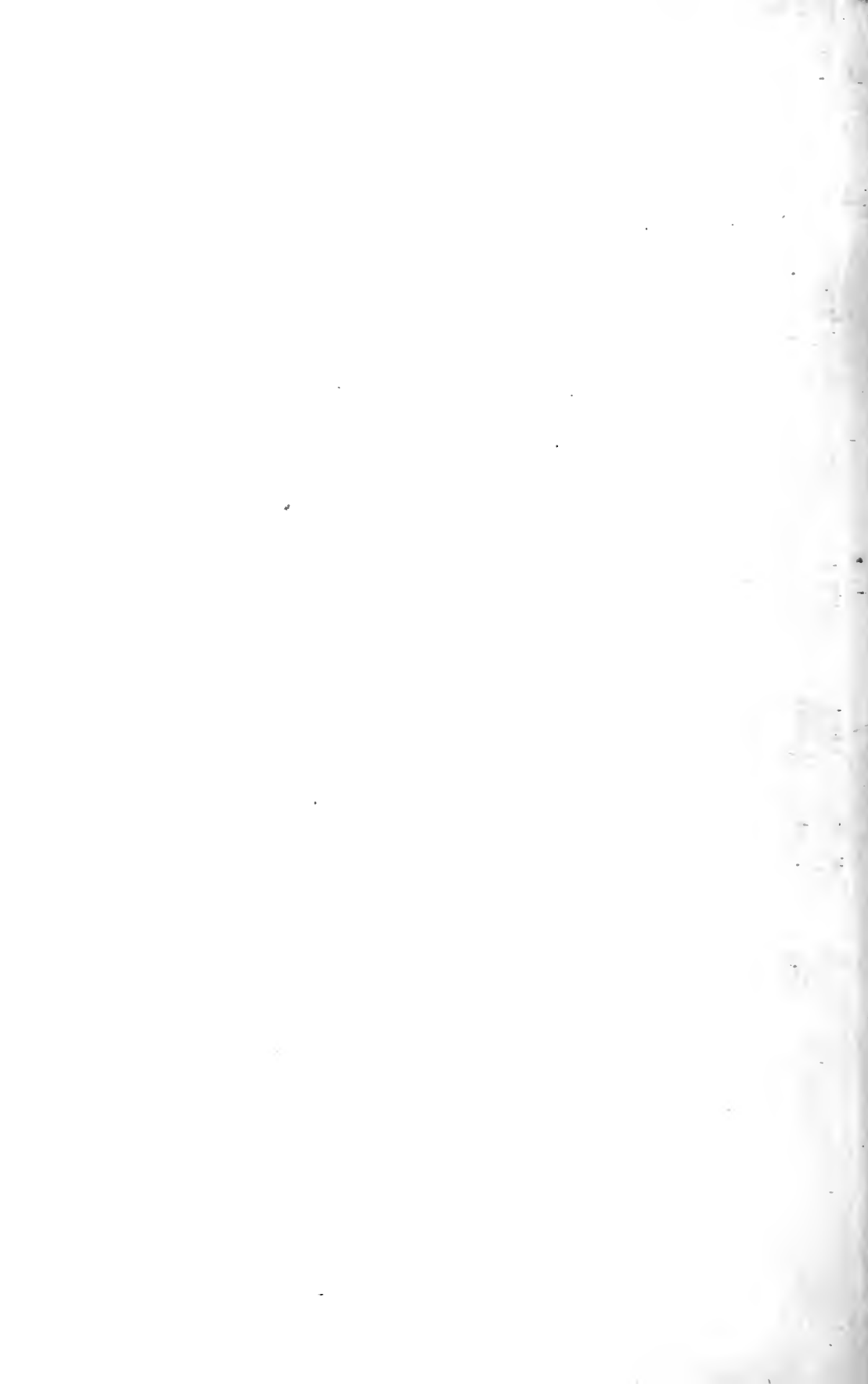
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